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

2010

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

Environmental Integrity Project, Earthjustice and Sierra Club

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Entity/Company – Location

Hyman Budoff / Merle & Charles Kittinger – Industrial Excess Landfill (IEL) Superfund Site
12464 Cleveland Avenue
Uniontown, OH 44685
Stark County
Latitude: 40.968689 Longitude: -81.405153

Determination

Demonstrated damage to off-site groundwater, including damage to many domestic drinking water wells

Probable Cause(s)

Coal combustion waste (CCW) is the likely source of metals contamination at levels above MCLs in numerous wells. CCW may also contribute to measured levels of alpha and beta radioactivity in more than a dozen wells.

Summary

The Industrial Excess Landfill (IEL), designated by the U.S. Environmental Protection Agency (USEPA) as a Superfund Site in 1984, received an estimated 1 million tons of coal ash from industrial boilers in the Akron/Canton area in the 1960s. In the 1970s, IEL received 1 million tons of industrial organic liquids and other wastes. Although the landfill contains a mixture of industrial wastes, only coal ash contains the toxic heavy metals found in on-site and off-site groundwater wells.

Locations of MW14 (within landfill) and off-site monitoring wells are approximate.

IEL is located in a former sand and gravel pit with residential areas to the north, west and south where hundreds of people depended upon private wells for drinking water. Widespread, significant exceedances of maximum contaminant levels (MCLs) for drinking water and other health-based standards for metals were found in monitoring well clusters located in or close to residential areas. Metals where drinking water standards have been exceeded (maximum exceedances in parentheses) include: antimony (52 times the federal standard), arsenic (13 times the federal standard), beryllium (30 times the federal standard), cadmium (53 times the federal standard), chromium (17 times the federal standard), lead (47 times USEPA's action level), thallium (6.5 times the federal standard), and nickel (12.4 times USEPA's former MCL). Radionuclides probably associated with the coal ash (radon), and anthropogenic radioisotopes where coal ash-colloids probably facilitated off-site transport (plutonium and technetium-99) have also migrated into the residential areas to the north, west, and south.

In 1987, USEPA, in response to the groundwater contamination, required 100 homes west of the site to be provided with free hook-ups to public water. Contamination by coal ash contaminants, however, was also detected to the north and south of the landfill. Thus, while the Agency has determined that the Superfund remedy is "complete," harm to residents who live in the vicinity of the site continues. Many residents in these areas cannot afford the $5,000 hookup fee and continue to use private wells. The neighborhoods southwest, west, and northeast of the landfill have had high incidences of cancer since at least the early 1990s.

Test of Proof

The Industrial Excess Landfill (IEL), located in Lake Township southeast of Uniontown, Ohio, covers about 30 acres and averages 45 feet in height. Prior to 1959, the property was mined for sand and gravel. From 1959 until the mid-1960s, materials approved by the Ohio Department of Health for inclusion in the landfill included coal fly ash, masonry rubble, paper, scrap lumber, and other non-toxic materials (Jackson et al. 1989). In the mid-1960s, coal fly ash was the primary waste placed at the landfill. The northwest and northcentral portions of IEL were lined with fly ash (ATDSR, 1998). Approximately one-third of the IEL landfill is filled with coal ash from industrial boilers in the Akron/Canton area (Weatherington-Rice and Aller, 2005). This represents an estimated 450-acre feet of coal ash totaling approximately 1 million tons. Starting in the late 1960s and through the 1970s, about 1 million gallons of industrial liquid wastes were dumped onto the ground and into an evaporation lagoon constructed on-site. In addition to industrial wastes, the landfill also accepted waste from hospitals, septic tank cleaning firms, and the general public. In response to increasing complaints by nearby residents, the Stark County Board of Health ordered IEL to stop dumping chemical wastes in 1972, but other waste disposal continued until the landfill ceased operations in 1980, and was covered with soil consisting of highly permeable sand and gravel (USEPA, 2009). The landfill was listed on the USEPA's National Priorities List (NPL) as a Superfund site in 1986, and USEPA claims that remedial action was completed in 2005 (see Regulatory Action section).

USEPA's remedial actions at the IEL landfill have focused almost exclusively on contamination by volatile organic chemicals (VOCs), and no mention is made in documents posted on USEPA Region 5's website that CCW was a significant source of groundwater contamination by metals at the site (USEPA Region 5, 2010). The evidence, however, supports the conclusion that coal ash at the IEL site is either exclusively or the predominant source of the extensive metals contamination documented at the site:

- All the metals found to exceed MCLs in off-site wells (antimony, arsenic, beryllium, cadmium, chromium, lead, nickel, and thallium) are present in Ohio coals. For example, concentrations of thallium, an extremely uncommon element for manufacturing, have been measured in coal ash with maximum concentrations ranging from 28 ppm (Stark County) to 150 ppm (Tuscarawas County), both likely sources of coal that was burned to create the ash. Lead, frequently detected above federal standards in off-site wells, commonly ranges from 40 to 210 ppm in Stark County coal ash. Uranium has been measured as high as 63 ppm in Stark County coal ash and 320 ppm in Tuscarawas County coal ash, and thorium up to 22 ppm in Stark County and 60 ppm in Tuscarawas County coal ashes (Botoman and Stith, 1986).

- The high pH in many wells also indicates that the coal ash at the site is the dominant influence on the inorganic contaminants. The natural geochemistry of the area, low-lime glacial tills and sand and gravels of Late Wisconsinan and Illinoian age, and mostly acidic sandstones, shales, coal, and underclay, creates a low pH.
- Common metals found to be soluble in high pH settings include arsenic, cadmium, chromium, and lead, all coal ash metals that have been found in high concentrations off-site (Roadcap et al., 2005).

The alkaline conditions created by water percolating through the ash, and the fine-grained nature of the ash itself, creates conditions favorable for facilitated transport of colloidal precipitates and sorbed metals on colloidal-sized particles of ash, which are able to migrate through the permeable sand and gravel aquifer in which coal ash has been directly placed (Roadcap et al. 2005).

In 1987, the first systematic sampling of groundwater within and adjacent to the IEL landfill was undertaken (Jackson et al. (1989)). These first samples were split between consultants for USEPA, the industrial users of the site and the University of Akron's Center for Environmental Studies. Samples were collected from seven nested wells placed at the outer margins of the landfill, and five nested wells outside the landfill boundaries (well nests are wells in the same location that are placed a different depths to sample different aquifers). Most well nests included shallow (S), medium (M or I) and deep (D) wells, with a total of 27 wells sampled. MCLs were exceeded for one or more metals in three downgradient well nests on the south margin of the landfill (MW1S&M, MW3M&D and MW7S,M&D—groundwater in these wells is moving off-site), in three downgradient well nests off-site (MW6S, MW10S,M&D, and one downgradient well nest 900 feet east (MW8M&D) to the south of the landfill. Specific results of the sampling included:

- **Antinomy** exceeded the MCL of 0.006 mg/L in nine wells. Concentrations in four on-site wells (1S, 1M, 3M and 3D) ranged from 0.075 to 0.098 mg/L. Downgradient off-site well concentrations of antimony at 8M and 8D, located about 900 feet west of the landfill, ranged from 0.024 to 0.038 mg/L, 4.0 to 6.3 times the MCL.
- **Arsenic** exceeded the MCL of 0.01 mg/L in eight on-site wells (1S,&M, 3M&D and 7D&S), and one off-site well 8M (0.06 mg/L), the most distant well from the landfill. Concentrations ranged from 0.06 to 0.54 mg/L, up to 54 times the MCL.
- **Chromium** exceeded the MCL of 0.10 mg/L in one downgradient off-site well (6S), with a measured value of 0.18 mg/L.
- **Lead** exceeded the USEPA Action Level (AL) of 0.015 mg/L in four wells, three of them downgradient off-site wells (10S, 10M, and 10D). Concentrations ranged from 0.18 to 0.24 mg/L, 12 to 16 times the AL.

Since 1990, groundwater sampling has taken place at 27 locations with most locations having monitoring wells screened at three depths. Well sampling from May 1992 to 1993 found extensive exceedances of MCLs in downgradient ***off-site*** monitoring wells (data summarized from Exhibit 41 in BWEC, 1999):

- **Antinomy** exceeded the MCL of 0.006 mg/L in six wells (8S, 18S, 23S, 24S, 25S and 27s) with concentrations ranging from 0.061 to 0.315 mg/L, 10 to 52 times the MCL.
- **Arsenic** exceeded the MCL of 0.01 mg/L in three wells (18S, 23S and 24S) with concentrations ranging from 0.055
- to 0.132 mg/L, 5 to 13 times the MCL.
- **Barium** exceeded the MCL of 2.0 mg/L in three wells (OW-9, 24S and 27S) with concentrations ranging from 2.1 to 2.3 mg/L.
- **Beryllium** exceeded the MCL of 0.004 mg/L in eight wells (8S, 18S, 19S, 21S, 23S, 24S, and 27S), with concentrations ranging from .0052 to 0.121 mg/L, up to 30 times the MCL.
- **Cadmium** exceeded the MCL of 0.005 mg/L in nine wells (1D, 8D, 18S, 12I, 23S, 24S, 25S, 27S and 28D) with concentrations ranging from 0.0054 to 0. 0.265 mg/L, up to 53 times the MCL.
- **Chromium** exceeded the MCL of 0.10 mg/L in eight wells (8S, 18S, 21I, 24S, 24I, 25I, 25S, and 27S) with concentrations ranging from 0.127 to 0.739 mg/L, up to 7 times the MCL.

- **Lead** exceeded the AL of 0.15 mg/L in 26 wells (1D, 6S, 8D, 8S, 10D, 10S, 11D, 11S, 18I, 18S, 19S, 21I, 21S, 23I, 23S, 24S, 24I, 25I, 25S, 26S, 27D, 27I, 27S, 28D, OW8, OW9), with concentrations ranging from 0.0161 to 0.70 mg/L, up to 47 times the AL.
- **Mercury** exceeded the MCL of 0.002 mg/L in two wells (27S and OW11), with concentrations ranging from 0.0024 to 0.0055 mg/L, up to 2.75 times the MCL.
- **Nickel** exceeded the MCL of 0.10 mg/L, which was applicable at the time of sampling, in 13 wells (8S, 10S, 11I, 18S, 21I, 21S, 23S, 24I, 24S, 25I, 25S, 26S, 27S) with concentrations ranging from 0.113 to 1.24 mg/L, up to 12.4 times the MCL. (This MCL was remanded in 1995.)

Geraghty & Miller (1997), consultants for the potentially responsible parties (PRPs) at IEL argued that groundwater sampling since 1990 indicated that natural attenuation of metals at the IEL site was taking place and that no further actions were required to address metals contamination. Ohio EPA (OH EPA) objected to this assertion and released their own report with the following conclusions based on their review of the groundwater data (OH EPA, 1997):

- Several metals such as barium, nickel, cadmium, chromium, and zinc have shown concentration *increases* in groundwater at the site since 1993.
- Metallic contaminants were found at very high concentrations in nearly all of the off-site monitoring wells.
- The claim that metals exceeding MCLs near the landfill were due to natural conditions unrelated to land filling activities were unsubstantiated.
- The statement that statistical evaluation shows metal levels to be similar to background concentrations is unsupported.
- The claims that the metals are in geochemical equilibrium with their surroundings and that they are mobilized as precipitates are also unsupported.
- "Ohio EPA does not accept claims that dismiss the landfill as a source of significant metallic contamination…Nor does OEPA have any reason to believe that future releases of heavy metals will not occur."

Despite the strong evidence for off-site contamination of groundwater by metals, Sharp and Associates (2003), consultants for the PRPs at the IEL site, evaluated the 50+ monitoring wells at the IEL site in 2000, and recommended that 34 wells be abandoned. The basis for recommending that 18 of these wells be abandoned was that sampling indicated that they had been "clean" for ten or more years. Furthermore, the report claimed that 17 of the wells where monitoring was continuing were also clean.

A review of this report and available groundwater monitoring data by Weatherington-Rice and Aller (2005), consultants for Concerned Citizens of Lake Township (CCLT), found that MCLs for one or more metals had been exceeded since 1997 in most of the wells claimed to be clean. Furthermore, the consultants for CCLT found that the PRP consultants excluded pH as a parameter when evaluating whether a well was clean. Elevated pH indicates that groundwater has been affected by coal ash. If one considers wells where pH greater than 8.0, which is above natural groundwater conditions, has been measured, only 4 of the 35 wells claimed to be "clean" can be considered clean in terms of having no exceedances of MCLs or elevated pH since 1997.

Weatherington-Rice and Aller (2005) analyzed groundwater sampling data from 1997 to 2001 and identified 35 wells where MCLs had been exceeded for one or more metals. These 35 wells include five wells placed within the landfill, 15 wells that are located at the margin of the landfill with contaminants moving off-site, and 16 wells at ten off-site locations. The distance of off-site monitoring wells from the margin of the landfill ranges from several hundred feet to more than 1,600 feet. Six of the off-site wells with MCL exceedances have been abandoned. As has already been discussed, the list of toxic metals where concentrations have exceeded MCLs is typical of metals associated with coal ash: including antimony, arsenic, cadmium, chromium, lead, selenium, and thallium.

Nineteen of the wells where MCLs have been exceeded since 1997 have been abandoned with the approval of the USEPA. Yet, for example, exceedances of MCLs at well MW12I, located about 1000 feet north of the project site, have been measured for cadmium, chromium, lead, selenium, and thallium. This is one of the most distant monitoring wells from the landfill, and the large number of metals with MCL exceedances suggests a preferential pathway for flow of contaminants to the north in the sand and gravels deposits in the north-trending bedrock valley east of the landfill.

A recent search of the database developed by Bennett & Williams Environmental Consultants for groundwater sampling data collected from 1991 to 2000 focused on identifying MCL exceedances for coal-ash related metals in off-site monitoring wells (all of which are located in or close to residential areas). The results of this search documents extensive off-site contamination (Weatherington-Rice, Zwierschke, and Aller, 2010):

- All 11 off-site monitoring well clusters (S, I & D combined for purposes of this summary) had MCL exceedances for at least two and as many as eight toxic metals: MW6 (As, Pb), MW8 (Cd,Pb), MW10 (As, Cd, Pb, Ni), MW12 (As, Cd, Pb, Ni, Tl), MW18 (Sb, As, Be, Cd, Cr, Pb, Ni, Tl), MW23 (As, Be, Cd, Pb, Ni), MW24 (Sb, As, Be, Cd, Cr, Pb, Ni), MW25 (Be, Cd, Cr, Pb, Ni), MW26 (Cd, Pb, Ni), MW27 (Sb, As, Be, Cd, Cr, Pb, Ni, Tl), and MW28 (Cd, Pb, Ni).
- MCL for antimony (0.006 mg/L) was exceeded in three well clusters: MW18 (0.099 mg/L), MW24 (0.161 mg/L), and MW27 (0.133 mg/L). The maximum value of 0.161 is 27 times the MCL.
- MCL for arsenic (0.01 mg/L) was exceeded in seven well clusters: MW6 (0.0135 to 0.0144 mg/L, MW10 (0.052 mg/L), MW12 (0.0124 to 0.0133 mg/L), MW18 (0.025 to 0.099 mg/L), MW23 (0.014 to 0.0279 mg/L), MW24 (0.0103 to 0.132 mg/L), and MW27 (0.0116 to 0.0797 mg/L).
- MCL for beryllium (0.002 mg/L) was exceeded in five well clusters: MW18 (0.0513 mg/L), MW23 (0.0052 to 0.0091 mg/L), MW24 (0.0054 to 0.0957 mg/L), MW25 (0.024 mg/L), and MW27 (0.0058 to 0.0121 mg/L).
- MCL for cadmium (0.005 mg/L) was exceeded in 10 well clusters: MW8 (0.0054 to 0.0115), MW10 (0.013 to 0.016), MW12 (0.0103 to 0.045 mg/L), MW18 (0.0053 mg/L), MW23 (0.0118 mg/L), MW24 (0.008 mg/L), MW25 (0.0051 to 0.0087 mg/L), MW26 (0.0083 mg/L), MW27(0.0074 to 0.014 mg/L), and MW28 (0.0095 to 0.265mg/L). The maximum value of 0.265 mg/L is 53 times the MCL.MCL for chromium (0.1 mg/L) was exceeded in four well clusters: MW18 (0.093 to 0.278 mg/L) , MW24 (0.168 to 0.214 mg/L) , MW25 (0.160 to 0.561 mg/L) , and MW27 (0.115 to 1.680 mg/L). The maximum value of 1.68 mg/L is 17 times the MCL.
- MCL for lead (0.015 mg/L) was exceeded in all 12 well clusters: MW6 (0.032 to 0.0665 mg/L), MW8 (0.017 to 0.0803 mg/L), MW10 (0.0175 to 0.107 mg/L), MW12 (0.032 to 0.0982 mg/L), MW18 (0.0206 to .0279 mg/L), MW23 (0.0198 to 0.0834 mg/L), MW24 (0.0174 to 0.659 mg/L), MW25 (0.0154 to 0.104 mg/L), MW26 (0.0226 mg/L), MW27 (0.060 to 0.453 mg/L), and MW28 (0.025 mg/L).
- The former MCL for nickel (0.1 mg/L) was exceeded in 10 well clusters: MW10 (0.120 to 0.193 mg/L), MW12 (0.139 to 0.921 mg/L), MW18 (0.142 to 2.2 mg/L), MW23 0.105 to 0.175 (mg/L), MW24 (0.211 to 1.240 mg/L), MW25 (0.150 to 0.698 mg/L), MW26 (0.123 to 1.550 mg/L), MW27 (0.219 to 0.735 mg/L), and MW28 (0.115 to 0.336 mg/L). The maximum value of 2.2 mg/L is 22 times the former MCL, but would not be considered an exceedances since it was sampled in 1997 after the the MCL was remanded.
- MCL for thallium (0.002 mg/L) was exceeded in four well clusters: MW12 (0.0129 mg/L), MW18 (0.0105 to 0.0125 mg/L), MW27 (0.0025 mg/L). The maximum value of 0.0129 is 6.5 times the MCL.

The focus of the recent groundwater database search was on off-site monitoring wells, but on-site MW14 was also included for comparison. This well had exceedances or arsenic, beryllium, cadmium, chromium, lead, nickel and thallium as follows: arsenic (0.0202 to 0.139 mg/L), beryllium (0.005 mg/L), cadmium (0.007 to 0.0152

mg/L), chromium (0.104 to 0.16 mg/L), lead (0.146 to 0.268 mg/L), nickel (0.160 to 0.254 mg/L) and thallium (0.0102 mg/L).

Furthermore, a variety of technically questionable sampling procedures appear to have led to measured contaminant levels that may well be *lower* than actual concentrations. These include:

- Samples collected starting in 1998 used low-flow sampling procedures in a way that collected stagnant water in the wells rather than representative groundwater samples, as indicated by lack of stabilization of field parameters (Lake Township, 2001; Weatherington-Rice and Aller, 2005). One of USEPA's own geologists noted inadequate purging in the November 2000 sampling event (USEPA, 2001). Sampling stagnant water from a well can underestimate metals and radionuclides that sink to the bottom of the casing.
- Failure to resolve issues related to high pH readings in ten well nests may mask the potential for mobilization of metals in groundwater (Weatherington-Rice and Aller, 2005).
- Failure to preserve IEL samples for metals in the field with acid and blanket filtering of samples in the laboratory without also testing unfiltered samples has probably led to underestimation of metals and radionuclides.
- Sample detection limits for several samples collected in 1992 and 1993 were above the MCL (BWEC, 1999).
- Field filtering of all samples for radionuclides in 1992-1993 created a low bias for those sampling rounds.

The weight of evidence that on-site and off-site groundwater has been, and continues to be, contaminated by CCW is very strong. Large quantities of coal ash have been placed at the site. The toxic metals found in high levels in the groundwater, are typical of those found at other CCW disposal sites where groundwater contamination has occurred and are present in high concentrations in locally mined Ohio coals, which are the likely source of the ash. No other sources of significant metals contamination have been identified as having been disposed at the site. The permeable sand and gravel aquifers in the area allow contamination to move quickly off-site. Despite evidence of ongoing migration of toxic metals in groundwater flowing through residential areas near IEL, in 2004 19 wells where MCLs had been exceeded, eight located in or adjacent to residential areas, were decommissioned with USEPA's approval. The rest of the monitoring wells have not been tested for metals since 2004 (Borello, 2010). Ongoing off-site contamination by radionuclides, at least partly attributable to the CCW, is also occurring (see Additional Narrative).

Constituents Involved

Antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, and thallium; high pH; and various radioisotopes. No information is available for boron and molybdenum, signature CCW metals, because they have never been included in list of metals analyzed for at IEL.

Incident and Date Damage Occurred / Identified

Exceedances of MCLs for antimony, arsenic, chromium, and lead were discovered in nine wells when the first systematic groundwater sampling occurred in May 1987. Exceedances of metals and radionuclides have continued to be measured in on-site and off-site wells through 2001, the most recent sampling data available.

Regulatory Action

Records in the Stark County Health Department indicate that significant complaints about the site began in 1971. In 1983, local residents voiced concerns about pollution from the site to township officials, the Stark County Commissioners, the Stark County Health Department, the Ohio EPA and other governmental units (Jackson et al. 1989). In October, 1984 the site was proposed for inclusion in the National Priority List (NPL) of hazardous waste sites for cleanup under the Superfund program, and in June 1986 it was listed as Final on the NPL (USEPA, 2010). Residential well sampling performed in 1987 showed that private wells were being impacted by groundwater

contaminated by volatile organic contaminants (VOCs) and USEPA installed air strippers in the affected residences. That same year, USEPA signed a Record of Decision (ROD) requiring installation of an alternate water supply in an area containing 100 homes downgradient of the site to the west. In July 1989 USEPA signed a second ROD selecting actions to clean up the site, which included covering the entire site with a multi-layer cap, expanding the landfill gas extraction and treatment system, extracting and treating contaminated groundwater; and pumping groundwater to maintain the water table at a level that is below that of the wastes in the landfill.

However USEPA used the results of monitoring data collected in March 1997 and September 1998 to justify removing the pump-and-treat remediation system (USEPA, 2009). Then in September 2002, a final remedy was selected that eliminated the original ROD action of covering the entire site with a multi-layer cap, and implemented Monitored Natural Attenuation (MNA). For reasons that are unclear, USEPA also allowed the existing gas extraction and treatment system at the landfill to be shut down in 2005 (Borello, 2010). This is the system that ATDSR (1989) considered to be inadequate to protect the health of nearby residents. Other than ongoing monitoring, remedial activities were completed in May 2005 (USEPA, 2010).

There has been no sampling for metals at IEL since August, 2004 (OEPA, 2010). The EPA has not responded to requests from U.S. Senator Sherrod Brown from Ohio to document the basis for its decision to eliminate the provision the 1989 ROD to expand the landfill gas extraction and treatment system or the justification for shutting down the existing system around 2005 (Borello, 2010). In 2004, USEPA authorized the decommissioning of 33 monitoring wells, which further hampers the ability to evaluate the Monitored Natural Attenuation (MNA) at the site. Major controversy has surrounded USEPA's actions and interpretations of data on the contaminants that are present and the seriousness of remaining contamination at IEL site (see, OEPA, 1997, CCLT website listed in the Sources section, Weatherington-Rice and Aller, 2005, and discussion of evidence for contamination by anthropogenic radioisotopes in Additional Narrative, below).

Wastes Present

One million tons of coal ash from industrial boilers, masonry rubble, paper, scrap lumber, and other materials deemed to be non-toxic were placed in the landfill up to the mid-1960s. From the late 1960s to late 1970s the landfill received industrial organic chemical liquid wastes, waste from hospitals, septic tank cleaning firms, and the general public.

Type(s) of Waste Management Unit

Landfill without liners or cap in an abandoned sand and gravel quarry; lagoon for industrial organic chemical liquid wastes.

Active or Inactive Waste Management Unit

Inactive. Landfill ceased operation in 1980, and remedial action measures were deemed "completed" in 2005.

Hydrogeologic Conditions

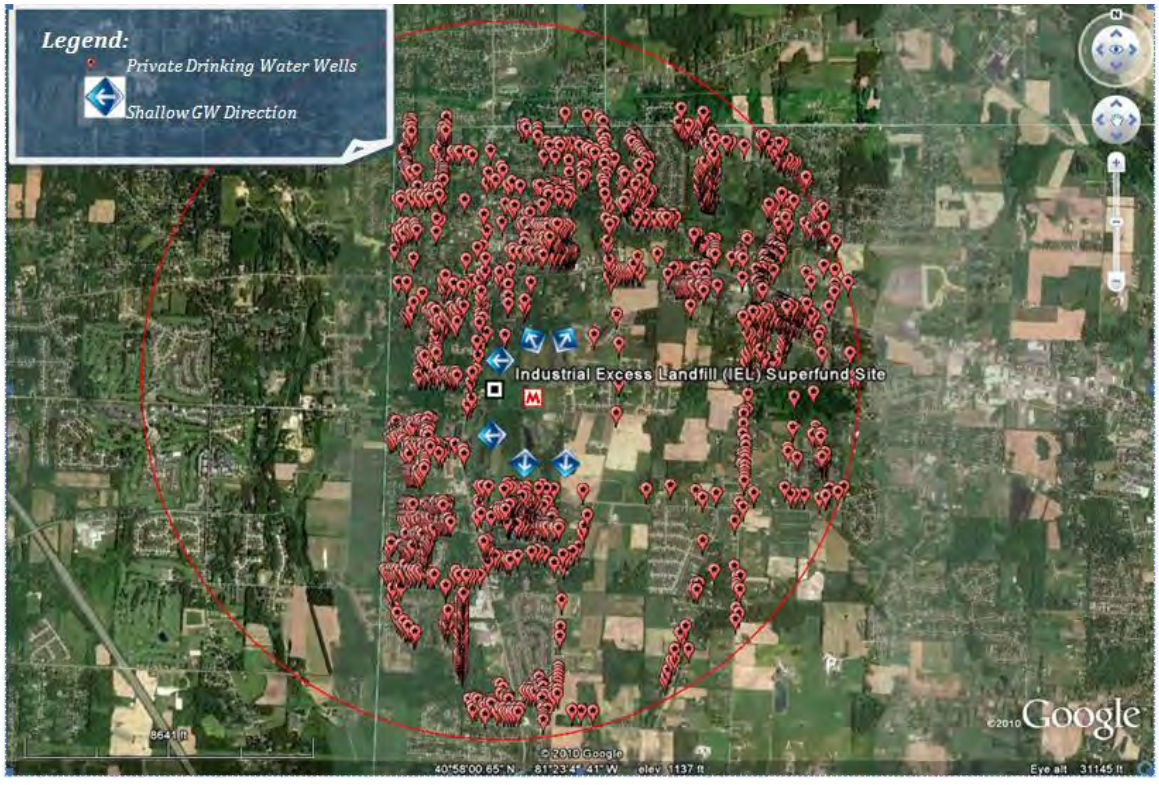
The IEL landfill is in a complex hydrogeologic setting with 50 to 140 feet of unconsolidated glacial kame moraine sand and gravel deposits on top of basal glacial till, overlying sand and gravel deposits. A SW-NE bedrock sandstone ridge beneath the landfill is flanked by two parallel valleys filled with sand and gravel outwash. A basal till approximately 5 to 10 feet thick lies on top of the sand and gravel outwash in the area of the landfill. The sand and gravel mined at the landfill was from kame moraine deposits up to about 60 feet thick overlying the basal till. Three aquifers are present in the area of the landfill: (1) a perched water table in the kame moraine deposits; (2) an intermediate aquifer in the sand and gravel below the basal till; and (3) a deep aquifer in the sandstone. Mounding of the water table in the area of the landfill (elevated groundwater levels within the landfill) results in groundwater flow in all directions from the landfill. The general direction of groundwater flow in the middle aquifer is to the west and south. The apparent direction of groundwater flow in the sandstone unit is to the

south. The sand and gravel aquifers are highly permeable (groundwater flow as high as 6 feet/day), allowing contaminants from the IEL site to quickly move off-site once they enter the groundwater system. As noted earlier, although the general direction of groundwater flow is to the west and south, the large number of metals with MCL exceedances in MW12I suggests there is also a highly permeable preferential pathway for flow of contaminants to the north in the sand and gravel deposits in the north-trending bedrock valley east of the landfill. In this area, pumping of residential wells has probably drawn contaminants to the north, across the normal westward groundwater gradient. Unfortunately, MW121 was decommissioned in 2004 (Summarized from Jackson et al., 1989)

At Risk Population

The locations of private wells, shown on the aerial map below, were obtained from the Ohio Department of Natural Resources' Well Query Database in 2010. This database allows the user to download locations of wells that are registered with the state at the county level. According to this database, there are 3,912 registered private wells within a two-mile radius of the IEL site. No public well data was available from Ohio DNR.

A well map compiled by Weatherington-Rice and Aller (2005) identifies about 90 private wells within 1,500 feet of the IEL site where some groundwater sampling data are available. In the late 1980s, an estimated 2,500 to 3,000 people lived within a one-mile radius of the IEL site (ATDSR, 1989). According to the 1990 Census, 27,121 people live within a three-mile radius of the site, including children below the age of nine years (USEPA, 2009). A narrow corridor of 100 homes west of IEL received free hook-ups to public water to replace wells that were contaminated. Residents northwest and southwest, who may have had contaminated wells, were required to pay a $5,000 hook-up fee, which not all homeowners could afford. It is possible that 30% the residents near IEL still use private wells. At least two of the four private wells where technetium-99 as found in 2005 were used for drinking water at the time of sampling (Borello, 2010).



Mounding of groundwater in the disposal area may cause localized flow in other directions.

Residents in the vicinity of the IEL site relied exclusively on private wells until USEPA required installation of an alternative water supply in 1989, about 15 years after residents began to be potentially exposed to contaminants from the initial disposal of fly ash in the highly permeable upper sand and gravel aquifer. The human health impact of this exposure and subsequent failures by USEPA to take adequate remedial actions at the IEL site have been tragic:

- By the early 1990s, Elaine Panitz, on the faculty at Princeton University, expressed concern to ATDSR about the incidence of cancer in the vicinity of IEL, including three cases of rare cancer (Panitz, 1992).
- The Lake Township Board of Trustees compiled information collected by Darlene Lansing, R.N., and from testimony by residents given at public hearings to develop a list, by cancer types, of cancer cases and the streets on which they occurred. Three areas show a high incidence of cancer west, southwest, and northeast of the IEL site (Lake Township, 1999 Exhibits L and M).
- Monitoring well 26I, which was decommissioned in 2004, is located in a neighborhood where cancers have been reported over the years in nearly every home (Borello, 2010)

Additional Narrative

The question as to whether radioactive wastes were placed in the IEL site has been the subject of considerable controversy.

Monitoring wells at the IEL site have been sampled for gross alpha and beta radioactivity in 2000 and 2001 by consultants for the PRPs. Review of these sampling results by Weatherington-Rice and Aller (2005) found the following:

- Alpha radioactivity exceeded 5 pCi/L in eight wells (12D, 6.82; 14S, 15.2 to 16.9; 14I, 6.08; 16I, 13.8; 17S, 10.9 to 25.9; 23S, 7.5 to 13.0; 26I, 7.2 to 9.5) and was detected in two additional wells (20D, 26S). When gross alpha concentrations exceed 5 pCi/L, testing for radium 226 and 228 should be performed to determine if the radium 226/228 MCL of 5 pCi/L has been exceeded. One well (14S) exceeded the MCL of 15 pCi/Lfor gross alpha radiation. Three of the wells where alpha radioactivity exceeded the MCL's for pCi/L were off-site. Earlier testing of four residential wells near the site for alpha radiation from 1991 to 1993 exceeded 5 pCi/L at RW42 (14), RW42 (11), RW64 (9.7) and RW72 (6.1) (Weatherington-Rice, Zwierschke and Aller, 2010).
- MCL for beta radioactivity (>50 pCi/L), which ATDSR (1989) has suggested is coming from the coal ash at the IEL site, was exceeded in two wells (14S, 60.7 to 70.6; 17S, 64.6 to 66.7) and was detected in 19 other wells (1D, 12D, 14I, 15S, 16I, 17D, 18I, 18S, 19S, 20D, 20I, 20S, 21I, 21S, 22I, 23D, 23I, 23S, and 26I). Seven of the wells where beta radioactivity was detected were off-site wells.
- Earlier sampling of residential wells found total beta radioactivity of 280 pCi/L in one residential well (RW42) on March 20, 1991 (Weatherington-Rice, Zwierschke, and Aller, 2010).

During a sampling event in November 2000, Radium-226 was detected in off-site well 23S and total Radium in on-site well 17S at concentrations above the MCL (Lake Township, 2001).

In July and October 2005, consultants for CCLT performed groundwater sampling for radioisotopes from two irrigation wells and four domestic wells north, northwest, west, and southwest of the IEL site, at depths ranging from 35 to about 100 feet. Samples were analyzed for uranium, plutonium, technetium, and radium. Results for uranium and plutonium were in accordance with naturally occurring radioactivity in undisturbed environments and radium 226+228 was measured at a maximum of 1.9 pCi/L. Technetium-99, an anthropogenic isotope, was detected in all samples at levels ranging from 2.7 to 6.9 pCi/L (Ketterer and Baskaran, 2006a). In another report, experts in environmental radiochemistry and isotope geochemistry, Ketterer and Baskaran (2006b), reviewed prior information related to radioactivity at the IEL site, with specific focus on evidence for anthropogenic radioactivity resulting from disposal of wastes at the site, as distinct from "naturally" occurring sources (which include radioisotopes from fallout from nuclear testing) and radioactivity associated with coal ash. The results of this review can be summarized as follows:

- Tritium in IEL vicinity samples exceed the anticipated concentrations of tritium in precipitation and surface waters by approximately one order of magnitude, though well below EPA's MCL of 20,000 pCi/L.
- A May 2001 sample from 14S detected Technetium-99 at a level of 16.49 pCi/L. Technetium-99 is a fission product, and its presence is usually associated with recycled uranium. It is also a decay product of Technetium-99m, a metastable isomer used as a radioactive tracer in medical tests. As noted above, sampling in 2005 found Technetium-99 in all off-site domestic and irrigation wells that were sampled. Technetium is a beta-emitter.
- Detectable plutonium in an on-site borehole soil sample at 92 feet, and levels of plutonium in groundwater samples from four wells (1D and 1I at the southwest corner of the landfill and off-site wells 23S and 26I) that are 100 to 100,000 times higher than values reported for natural water systems are "impossible to reconcile" with plutonium levels that would be expected from fallout from weapons testing.
- Evidence for non-naturally occurring uranium at IEL is inconclusive. However, USEPA has failed to adequately conduct appropriate analysis (namely, mass spectrometry) that could readily and definitively examine the uranium isotope compositions.
- The presence of high levels of gross alpha and gross beta radioactivity in some wells (data summarized above) suggest improper accounting for all alpha- or beta-emitting isotopes and/or generally unreliable radiochemical data.

The federal government has dismissed claims that radioactive contamination from plutonium is a concern at the site, and EPA's Science Advisory Board reviewed data from the site in 1994 and concluded that it was highly unlikely that radioactive contamination is, or was present at IEL. According to USEPA, since 1994 a "small fraction of samples [have] yielded possible detections at extremely low concentrations" (DOJ/USEPA, 2001).

Although USEPA continues to refuse to acknowledge the presence of radioactive wastes at the IEL site, the evidence for their presence summarized above is strong. The earlier discussion noted that ATSDR has suggested that elevated beta radiation detected in monitoring well samples at IEL are the result of fly ash disposal at the landfill (ATSDR, 1998). Also, as discussed earlier, coals mined in the vicinity of the IEL site are known to have elevated concentrations of uranium and thorium in their ash. Available information does not allow assessment of how much of the elevated radiation levels that have been found in groundwater come from coal ash and how much from other anthropogenic sources. Evidence supporting the conclusion that coal ash at that the IEL site is contributing to off-site elevated radiation in groundwater includes:

- The Radium-226, detected in off-site well 23S above the MCL, is a decay product of Uranium-238, which could well come from uranium in the coal ash at the IEL site. Radium-226 in turn decays to Radon-222, a gas. One study has shown that a coal ash landfill at Wright Patterson Air Force Base in Ohio produced concentrations of radon that have been calculated to exceed indoor radon concentrations in a hypothetical structure built on the landfill (Kryusiak, 1995).
- The Ohio Department of Health has identified IEL as a confirmed radiologically contaminated site with uranium and radon, both coal ash constituents (Ohio Department of Health, 1994).
- Off-site migration of soil-gas, VOCs and gaseous radioisotopes such as Radon-222 (an ash- associated contaminant) remain a concern at the IEL site. The initial Public Health Assessment for IEL found that the existing soil-gas collection and venting system may have been allowing significant concentrations of soil-gas to migrate off-site (ATDSR, 1989).

Colloidal-facilitated transport of inorganic contaminants is a well-established mechanism for movement of contaminants in aquifers (Huling, 1989). It has already been noted that alkaline conditions and the fine-grained nature of the coal ash itself created favorable conditions for colloidal-facilitated transport of metals at IEL. Colloids also have the potential to transport radionuclides (McCarthy and Zachara, 1989), and enhanced mobility of plutonium in the saturated zone has been observed in association with various silicate minerals at the Nevada Test Site (Kerting et al., 1999). It is likely that coal-ash colloids assisted in the transport of the plutonium found in off-site wells 23S and 26I (the latter well is now decommissioned), and the technetium-99 that was found in the six off-site wells that were sampled in 2005.

Sources

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Letter from Robert Williams, Director of Health Assessment and Consultation, to Chris Borello, Concerned Citizens of Lake Township (Apr. 23, 1998).

ATSDR. 1989. Public Health Assessment for Industrial Excess Landfill Uniontown, Stark County, Ohio CERCLIS No. ODD000377911 (July 21, 1989), *available at* http://www.atsdr.cdc.gov/HAC/pha/IndustrialExcessLandfillOhio/IndustrialExcessLandfill07211989.pdf.

Bennett & Williams Environmental Consultants (BWEC). 1999. Comments on the Existing Public Record for the Industrial Excess Landfill for the Revision of the 1989 Existing Record of Decision. (presented to USEPA Region V on Behalf of Lake Township Trustees, Stark County, Ohio (Apr. 12, 1999).

Borello, Chris. 2010. Email communications, June 18, July 2 and July 23, 2010.

Botoman, George and David Stith. 1986. Analyses of Ohio Coals, 1979–1980. Information Circular 52, Ohio Department of Natural Resource, Division of Geological Survey.

Concerned Citizens of Lake Township (CCLT). 2010, http://www.afsc.net/cclt/index.htm.

Department of Justice and U.S. Environmental Protection Agency (DOJ/USEPA). 2001. Fact Sheet on Allegation of IEL Dumping (Dec. 2001).

Geraghty & Miller, Inc. 1997. Evaluation of Groundwater Chemistry and the Natural Attenuation Processes, (Oct. 1997) (cited by OEPA, 1997).

Huling, Scott G. 1989. Facilitated Transport. Ground Water Issue Paper. EPA/540/4-89/003).

Jackson, J.L., J.R. Bauder, J. Hardy, and M.S. Kennedy. 1989. Field Studies: Hardy Road Landfill and Industrial Excess Landfill, a Superfund Site. *Ohio J. Sci.* 89(3):45-55.

Kersting B., D.W. Efund, D.L. Finnegan, D.J. Rokop, D.K. Smith, and J.L. Thompson. 1999. Migration of Plutonium in Groundwater at the Nevada Test Site. *Nature* 397:56-59.

Ketterer, Michael E and Mark Baskaran. 2006a. Report of Sampling and Analytical Activities: Groundwater from the Vicinity of the Industrial Excess Landfill, Uniontown, Ohio. Final Report, (Feb. 3, 2006) (prepared for Concerned Citizens of Lake Township).

Ketterer, Michael E and Mark Baskaran. 2006b. Review of Evidence for Anthropogenic Radioactivity at the Industrial Excess Landfill, Uniontown, Ohio. Final Report (Mar. 26, 2006) (prepared for Concerned Citizens of Lake Township).

Krysiak, Richard S. 1995. Determining the Effects of Waste Coal Ash on Landfill Radon Levels. MS Thesis, Air Force Institute of Technology, Wright Patterson Air Force Base, Ohio,*available at* http://www.stormingmedia.us/76/7636/A763603.html.

Lake Township. 2001. Letter from Thomas Shalala to Richard Laubacher, Goodyear Tire and Rubber Company, Re: Lake Township Comments on Summary Report on the November 2000 Sampling Event, Industrial Excess Landfill, Uniontown, Ohio (Mar 2, 2001).

Lake Township. 1999. Comments of the Board of Lake Township Trustees on the Proposed changes to the Remedy at the Industrial Excess Landfill Superfund Site, *available at http://www.afsc.net/cclt/letter1.htm*.

Ohio Department of Health. 1994. Confirmed Radiologically Contaminated Site in the State of Ohio.

McCarthy J.F., and J.M. Zachara. 1989. Subsurface Transport of Contaminants. *Environ. Sci. Tech.* 23:496-502.

Ohio Environmental Protection Agency (OH EPA). 2010. Email from Lawrence Antonelli, Site Coordinator, OEPA Division of Emergency and Remedial Response, to Chris Borello (July 7, 2010).

OH EPA. 1997. Letter from Lawrence Antonelli, Site Coordinator, Division of Emergency and Remedial Response to Ross del Rosario, Remedial Project Manager, USEPA Region 5 re: Ohio EPA review of October 1997 Evaluation of Groundwater Chemistry and the Natural Attenuation Processes, the September 1997 Recommendation to Implement a Phytoremediation Landfill Cover System, and the Preliminary Remedial Design Plan, Industrial Excess Landfill, Stark County, Ohio (Dec. 24, 1997).

Panitz, Elaine. 1992. Letter of Elaine Panitz, Ph.D., Princeton Univeristy to Thomas Grumbley, ATDSR (July 25, 1992) (exhibit K in Lake County (1999).

Roadcap et al. 2005. Geochemistry of Extremely Alkaline (pH>12) Ground Water in Slag-Fill Aquifers. *Ground Water 43(6):806-816* (cited by Weatherington and Aller, 2005).

Sharp and Associates. 2003. Summary Report on an Assessment of Individual Groundwater Monitoring Wells at the Industrial Excess Landfill (IEL) Site and the Regional Hydrogeologic Setting. Prepared for IEL Potentially Responsible Parties, 2000, revised 2003 (cited by Weatherington-Rice and Aller, 2005).

U.S. Environmental Protection Agency (EPA). 2010. Superfund Site Progress Profile: Industrial Excess Landfill, *available at*http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0504014#ContamExp (last updated June, 2010).

USEPA Region 5. 2010. IEL Superfund Site, http://www.epa.gov/Region5/sites/iel/index.htm.

USEPA. 2009. Industrial Excess Landfill NPL Fact Sheet, *available at:* http://www.epa.gov/region5superfund/npl/ohio/OHD000377911.htm (last updated August, 2009).

USEPA. 2001. Memo from Dr. Luanne Vanderpool, Geologist, Region V Remedial Response Section to Ross del Rosario, RPM Superfund Division, Re: Summary Report of November 2000 Sampling Event, Industrial Excess Landfill, Uniontown, OH (June 26, 2001).

Weatherington-Rice, Julie and Linda Aller. 2005. Review of Ground-water Monitoring Well Sampling techniques, the pH "Issue", and the Wells Abandoned and Sealed Summer 2004(prepared by Bennett & Williams Environmental, Consultants for Concerned Citizens of Lake Township) (Dec. 21, 2005).

Weatherington-Rice, Julie Kerry Zwierschke, and Linda Aller. 2010. Search of Bennett & Williams Groundwater Sampling Database for IEL Site.