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September 30, 2015

VIA EMAIL & OVERNIGHT DELIVERY

Information Quality Guidelines Staff
Mail Code 2811T
U.S. EPA West (Old Customs Building)
1301 Constitution Avenue, NW
OEI Quality Staff, Suite 2335
Washington, DC 20004

Re: Walter Coke petition to correct EPA Region 4's dissemination of faulty XRF data and resulting cleanup decisions at the 35th Avenue Site

Dear Sir or Madam:

We are counsel to Walter Coke Inc. ("Walter Coke") regarding environmental matters in Birmingham, Alabama. On Walter Coke's behalf, we hereby submit the attached Information Quality Act Petition requesting that EPA promptly correct certain information it has disseminated regarding the 35th Avenue Superfund Site.

Walter Coke would welcome any productive dialogue during EPA's evaluation of this Petition.

Respectfully,

ROBERT D. MOWREY
C. MAX ZYGMONT

cc: Agency for Toxic Substances and Disease Registry
The Honorable Jeff Sessions
The Honorable Richard C. Shelby
The Honorable Terry Sewell
Lance LaFleur, ADEM Director
Robert J. Bentley, Governor of the State of Alabama
William A. Bell, City of Birmingham Mayor
Heather McTeer Toney, EPA Region 4 Administrator
Marianne Lodin, EPA Region 4
Steven Smith, EPA Region 4

WALTER COKE, INC. INFORMATION QUALITY ACT PETITION TO CORRECT EPA REGION 4'S DISSEMINATION OF CLEANUP DECISIONS AND XRF RESULTS AT THE 35TH AVE SUPERFUND SITE

Walter Coke, Inc. hereby petitions EPA under the Information Quality Act to promptly correct inaccurate and misleading data and cleanup decisions that it has disseminated and continues to disseminate about the 35th Ave Superfund Site (the "Site"). At the Site, EPA has analyzed metals and PAH concentrations in approximately 1,100 properties in North Birmingham's Collegeville, Fairmont, and Harriman Park neighborhoods. From this sampling, EPA determined that levels of arsenic and/or lead warrant soil replacement at approximately 321 properties, and EPA disseminated that information through multiple outlets, including the internet.[1]

But for 86 percent of samples, the only available data is from an x-ray florescence ("XRF") field instrument, and basic statistical analyses show that the XRF arsenic and lead results are so inaccurate that they do not satisfy EPA's own guidance for when XRF results may be used for screening purposes—let alone making cleanup decisions. As a result, EPA has reached and disseminated a large quantity of badly flawed data and has informed the public of actual or tentative cleanup decisions having no real basis in fact. As such, EPA's lead and arsenic XRF results and the cleanup decisions based on them fail to meet the level of quality that the Information Quality Act requires for disseminated information.

Now, EPA must make corrective public communication. And time is of the essence because EPA provided its fatally flawed XRF data to ATSDR, and ATSDR accepted that data and used it as the basis of its July 22, 2015 draft Health Consultation for the Site.[2] Unless EPA promptly notifies ATSDR that the XRF data is unusable, ATSDR may finalize the Health Consultation using that data and thereby perpetuate false impressions of risk that EPA has already created by disseminating that information in the first place. Matters as sensitive as Health Consultations and the decision whether an individual property needs to be cleaned up should be made using sound science so that the public can trust in them. EPA's lead and arsenic XRF results and the resulting cleanup decisions simply do not measure up.[3]

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[1] In addition to metals, EPA tested for PAHs and did so through laboratory analysis only. When exclusively PAH-driven cleanup decisions are included, EPA has determined that a total of approximately 400 properties require cleanup.

[2] ATSDR.CDC.GOV, Health Consultation, Public Comment Version, Evaluation of Surface Soil and Garden Produce Exposures, 35th Avenue Site (July 22, 2015), http://www.atsdr.cdc.gov/HAC/pha/35thAvenueSite/35thAvenueSite_HC(PC)_%2007-22-2015_508.pdf (Exhibit A)

[3] "Sound science" is one of EPA's purported Guiding Principles for the North Birmingham Environmental Collaboration Project, but the data problems discussed in this Petition call EPA's

Executive Summary

At the Site, EPA has analyzed metals and PAH concentrations in approximately 1,100 properties in North Birmingham's Collegeville, Fairmont, and Harriman Park neighborhoods. For 86 percent of the samples, EPA analyzed metals concentrations using only the XRF. For the remaining 14 percent of samples, EPA used the XRF and also sent them for confirmatory laboratory analysis. EPA then compared each yard's highest available lead or arsenic sampling result (whether from the lab or XRF) to EPA's chosen Removal Management Levels ("RMLs") and determined that levels of arsenic and/or lead warrant soil replacement at approximately 321 properties.[4] Then, EPA disseminated the sampling results and its cleanup decisions for each property to residents, potentially responsible parties ("PRPs")[5], other agencies such as ATSDR, and the public.

These results and cleanup decisions fail to satisfy the requirements of EPA's Information Quality Act Guidelines ("IQA Guidelines").[6] EPA's IQA Guidelines require information the agency disseminates to be of such a quality that the information possesses objectivity, utility, and integrity. EPA's arsenic and lead XRF data at the 35th Avenue Site and the resulting cleanup decisions lack objectivity and utility because, in short, the XRF is EPA's sole source of arsenic and lead based data and cleanup decisions for 86 percent of its samples, and statistical comparison of the lab and XRF results for the other 14 percent of samples shows that the XRF results are meaningless, because they are so weakly related to actual soil concentrations.

More specifically, the XRF data and resulting cleanup decisions lack objectivity and utility because they are

- **Inaccurate and unreliable**—comparing arsenic and lead XRF and lab results for the 14 percent of samples with both reveals correlation coefficients for lead and arsenic so low that there is little-to-no correlation between soil concentrations recorded by the XRF devices and the true soil concentrations as indicated by the lab. The correlation coefficients are so low that EPA's own guidance would disallow this data

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commitment to sound science at the Site into doubt, especially if EPA leaves the data's dissemination uncorrected. *See* EPA.GOV, http://www2.epa.gov/north-birmingham-project.

[4] The analyses in this Petition are based on an arsenic RML of 39 ppm because that is the RML EPA used when notifying residents of property-specific sampling results and cleanup decisions. Since so notifying residents, the arsenic RML has changed to 61 ppm, and Walter Coke has confirmed that the points set forth in this Petition apply equally if that RML is used.

[5] EPA.GOV, http://www2.epa.gov/north-birmingham-project/general-notice-letters-sent-prps

[6] U.S. Environmental Protection Agency, *EPA's Guidelines for Ensuring and Maximizing the Quality, Objectivity, Utility, and Integrity of Information Disseminated by the Environmental Protection Agency* (2002), http://www.epa.gov/quality/informationguidelines/documents/EPA_InfoQualityGuidelines.pdf.

from being used for screening, let alone for making ultimate cleanup decisions. EPA would reject out of hand the submission of such data by a private party.

- **Unclear and incomplete**—EPA has withheld from the recipients of the XRF data and the resulting cleanup decisions (*i.e.*, the public) that the data is seriously flawed. Rather, EPA implicitly represents that the data and its decisions are sound and authoritative.

- **Biased**—EPA reported to residents and made cleanup decisions based on XRF results even when there was a lower lab result available for the same yard, demonstrating a bias in favor of cleaning up properties regardless of need. Given the XRF arsenic and lead results' unreliability, EPA's choice to use known, false positive XRF data instead of lab data is not merely a conservative approach. Rather, it is the choice to manufacture a problem where one does not exist.

Early on in EPA's sampling, the agency's Technical Services Section ("TSS") recognized these problems and recommended corrective measures to achieve some modicum of data quality for lead and arsenic, but EPA ignored TSS's recommendations.[7] Walter Coke also repeatedly raised these issues with the agency in 2014.[8] And EPA tacitly acknowledged these issues by relying exclusively on lab data when evaluating the Site[9] for potential inclusion on the National Priorities List.[10] Nevertheless, EPA continues to disseminate and engender reliance on this faulty data through multiple outlets, including by providing the data to ATSDR to be the basis of its July 22, 2015 draft Health Consultation for the Site.

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[7] Memorandum from Glenn Adams, TSS Chief, to Greg Harper, On-Scene Coordinator, Recommendations for Use of XRF and Sieving of Soils (February 12, 2013) (Exhibit B).

[8] Letter from Robert Mowrey to Marianne Lodin, Re: 35th Avenue Superfund Site (January 31, 2014)(Exhibit C); Letter from Robert Mowrey to Marianne Lodin, Re: 35th Avenue Superfund Site (February 26, 2014)(Exhibit D).

[9] *See* HRS Documentation Record, 35th Avenue, ALN000410750, http://www.epa.gov/superfund/sites/docrec/pdoc1897.pdf.

[10] Based on Hazard Ranking System scoring, EPA has proposed the Site for NPL listing, but as Walter Coke explained in comments on the proposed listing, EPA's proposal is fatally flawed for a number of reasons, including because EPA used unjustifiably low background levels for arsenic and PAHs to artificially inflate the Site's Hazard Ranking System score.

Now, corrective public communications are urgently needed to retract the disseminated information, and in particular to help ATSDR avoid the embarrassment of finalizing a report based on unusable data. EPA should issue the corrective public communications in the same ways that it disseminated the XRF data and cleanup decisions—including public meetings, website postings, fact sheets, notices mailed directly to residents, and through direct contact with ATSDR. The corrections should communicate that:

1. EPA's XRF data was flawed,
2. The XRF data was the exclusive source of metals data for 86 percent of samples,
3. EPA incorrectly disseminated XRF data for many yards for which lab data was also available,
4. The XRF data is so flawed that it cannot be used for making cleanup decisions or relied on for any purposes, including for an ATSDR Health Consultation, and
5. That it is likely that many of the cleanup decisions EPA has made based on the XRF data are wrong, and therefore, EPA is withdrawing all such cleanup decisions for reevaluation.

Discussion

I. EPA's data collection and analysis at the 35th Avenue Superfund Site.

The Site includes some or all of the North Birmingham neighborhoods of Collegeville, Fairmont, and Harriman Park. Current property uses in these neighborhoods include residential, commercial, and industrial. Historically, North Birmingham has been heavily industrialized by scores of current and former industrial facilities, railroads, roadways, and an airport.

As part of its investigations at the Site, EPA through a contractor has collected and analyzed a total of 4,767 samples from approximately 1,100 properties in these neighborhoods. For illustration, sampling at a typical residence was done as follows: The front yard and back yard were sampled separately. In each yard, five surface soil (0-6") aliquots were taken in a "five on a die" pattern. Each yard's aliquots were combined to form a composite sample for that yard. The composite sample was then divided into a sieved and unsieved portion.

For all yards, the sieved and unseived portions were analyzed for metals using the XRF and were sent to the lab for PAH analysis. For roughly 86 percent of samples, the XRF results are the only metals data available. The remaining 14 percent were subject to both XRF and lab analysis for metals. The purpose of the lab analysis is to confirm whether the XRF is generating quality data usable for screening or decision-making.

Based on the resulting data, EPA determined that approximately 400 properties needed to be cleaned up due to RML exceedances of lead, arsenic, and/or PAHs.[11] Of those, 321 are driven at least in part by arsenic and/or lead concentrations, and 266 are driven by these metals alone. And of those 266, 223 are driven by XRF data alone. Due to XRF data problems explained below, EPA's decision that these 223 require cleanup lacks quality in the extreme. In addition, the XRF problems reflect such a total disregard for sampling protocols, statistics, and EPA guidance that they reveal systemic sloppiness in the collection of data from the Site and cast doubt on even the metals and PAH lab results that are driving EPA's other cleanup decisions.

II. Walter Coke is entitled to seek corrective measures regarding EPA's XRF data and the resulting cleanup decisions.

EPA's IQA Guidelines describe the mechanism for "*affected persons* to seek and obtain . . . correction of *information disseminated* by EPA that does not comply with EPA or OMB [IQA] Guidelines."[12] Here, Walter Coke is clearly an affected person, and EPA's XRF data and the resulting cleanup decisions are "information disseminated" by EPA within the meaning of the IQA Guidelines.

EPA's IQA Guidelines define "information" broadly to generally include "any communication or representation of knowledge such as facts or data, in any medium or form."[13] Obviously the XRF data are data. The resulting cleanup decisions, as EPA's representation that it knows that a yard needs to be cleaned up due to environmental conditions, are purported facts. Therefore, EPA's XRF data and the resulting cleanup decisions fall within the Guidelines' broad notion of information.

EPA has "disseminated" this information because it prepared and distributed it—and continues to do so—to "support or represent [the Agency's] viewpoint" or "position."[14] For instance, EPA posted to its website PRP General Notice Letters reciting that EPA has concluded that approximately 400 properties require cleanup.[15] The December 2013 EPA North Birmingham Environmental Collaboration Project Fact Sheet available on EPA's

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[11] *See* Offer to Conduct Work for the 35th Avenue Superfund Site in Birmingham, Jefferson County, Alabama, EPA.GOV, http://www2.epa.gov/sites/production/files/2013-09/documents/35th-ave-al-walter-coke-opportunity-to-do-work-2013-09-20.pdf.

[12] *See* EPA IQA Guidelines at 30 (emphasis added).

[13] *See id.* at 15.

[14] *See id.*

[15] EPA.GOV, http://www2.epa.gov/north-birmingham-project/general-notice-letters-sent-prps.

website also recites that "[a]pproximately 392 properties contain concentrations of various contaminants higher than EPA's [RMLs]."[16] That recitation is essentially repeated again in EPA's October 2014 North Birmingham Environmental Collaboration Project Multimedia Update available on EPA's website.[17] EPA further communicated these same messages through public meetings. EPA also notified the public of property-specific results and cleanup decisions through letters to residents. In addition, EPA sponsored ATSDR's July 22, 2015 draft Health Consultation by providing its faulty data to ATSDR to be the basis of ATSDR's analysis.

Walter Coke is affected by EPA's dissemination of this information because Collegeville, Fairmont, and Harriman Park grew up around Walter Coke's facility, and EPA and plaintiffs' lawyers have frequently alleged that the facility is a source of arsenic and lead concentrations EPA purports to have detected in the neighborhoods.[18] For example, one suit filed by a property owner against Walter Coke attached EPA's letter concerning its sampling at that property. But the results EPA reported to the owner were XRF results, while the lab results available for the property were much lower and, in fact, did not indicate a need for cleanup. In addition, EPA has named Walter Coke as a PRP at the Site, and Walter Coke has reason to believe that EPA will attempt to recover its sampling and cleanup costs from Walter Coke and other PRPs. Setting residents aside, if Walter Coke is not affected by this disseminated information, then no one is.

III. The XRF data and EPA's cleanup decisions based on them fail to satisfy EPA's IQA Guidelines.

Under EPA's IQA Guidelines,[19] information disseminated by EPA must satisfy certain criteria, including "objectivity" and "utility."[20] Information is "objective" if presented in "an accurate, clear, complete, and unbiased manner, and as a matter of

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[16] U.S. Environmental Protection Agency, FACT SHEET, North Birmingham Environmental Collaboration Project, http://www2.epa.gov/sites/production/files/2013-12/documents/north-birmingham-multi-fact-sheetfina-12-12-13.pdf.

[17] U.S. Environmental Protection Agency, North Birmingham Environmental Collaboration Project (October 2014), http://www2.epa.gov/sites/production/files/2013-12/documents/north-birmingham-multi-fact-sheetfina-12-12-13.pdf.

[18] Walter Coke has made repeated scientific demonstrations to EPA that it is not the source of lead and arsenic concentrations EPA has detected at the Site, and the agency has never attempted to rebut Walter Coke's demonstrations, preferring to ignore them.

[19] "Integrity" is a third prong of quality. *See* EPA IQA Guidelines at 15. "'Integrity' refers to security, such as the protection of information from unauthorized access or revisions . . . ." *Id.* Walter Coke is not currently aware of any reason to question the "integrity" here, but reserves its rights to raise such issues in the future as they may be discovered or develop.

[20] *See* EPA IQA Guidelines at 3.

substance, [if] accurate, reliable, and unbiased."[21] "Utility" refers to the usefulness of the information to the intended users.[22] Applying these criteria, it is clear that EPA's XRF data and the cleanup decisions based on them fail the objectivity and utility prongs.

A. EPA's XRF data and the cleanup decisions based on them lack objectivity because they are inaccurate, unreliable, unclear, incomplete, and biased.

An XRF device can report reliable metals data under certain circumstances. To confirm whether the XRF is doing so for a given site, a random subset of samples should be sent to the lab for analysis, as well.[23] The lab results must then be statistically compared to the corresponding XRF results to determine whether the XRF is providing accurate and reliable results.[24] Here, such statistical analyses show that EPA's XRF lead and arsenic results are so inaccurate and unreliable that they cannot support cleanup decisions.

Specifically, EPA guidance requires that the correlation coefficient between the lab sample set and the corresponding set of XRF results be determined.[25] According to EPA's guidance, the correlation coefficient must be at least 0.7 (on a scale of 0.0-1.0) for the XRF data to be usable for screening, and a coefficient of at least .9 is required for the XRF data to be used for decision making.[26] Here, EPA is using XRF data for decision making, but the arsenic and lead correlation coefficients are far below .9.

For lead, the correlation coefficient is 0.67—not even good enough for screening. The arsenic correlation coefficient is shockingly low at 0.399. At this correlation, the XRF provides no useful information about the true arsenic concentration in the analyzed soil. Indeed, at this correlation, the XRF is more akin to a random number generator. In fact, two things that have no relationship whatsoever—Alabama's annual average daily rainfall and the losing team's score in the Super Bowl over the past 30 years—have a stronger

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[21] *Id.* at 15.

[22] *Id.*

[23] USEPA SW-846 Method 6200, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment (February, 2007), Section 9.7 at 15.

[24] *Id.*

[25] *Id.*

[26] *Id.* (Stating that a .9 correlation constant can be considered definitive; however, a correlation constant of .7 requires additional screening).

correlation coefficient of 0.424. Would anyone ever accept rainfall totals in Alabama to be predictive of a Super Bowl score? Nor should the arsenic XRF results be accepted.[27]

When Walter Coke first brought these low correlation coefficients to EPA's attention in January 2014, EPA disputed Walter Coke's analysis based on a February 12, 2013 EPA TSS Memorandum.[28] But that Memorandum only underscores EPA's data problem. First, the Memorandum warned EPA of its XRF problems: TSS compared the lead and arsenic XRF and lab results for some of EPA's initial Site sampling and concluded based on correlation coefficient analyses that EPA needed to take remedial measures to ensure that its data could be used for decision making. Second, EPA ignored TSS's recommended remedial measure. TSS recommended that EPA send to the lab every sample with an XRF lead result between 200 and 600 mg/kg, as well as every sample with an arsenic result above 40 mg/kg and a lead result below 600 mg/kg. Following that recommendation would have resulted in 1,329 samples going to the lab for metals analysis, but only 650 did. In sum, EPA knew early on that it had a data quality problem but stuck its head in the sand.

TSS's subsequent March 20, 2014 Memorandum is similarly unhelpful to EPA.[29] There, TSS stated, "TSS continues to support the use of the XRF in the field at the Site and for decision making purposes."[30] But that continued support was premised on EPA implementing TSS's February 2012 remedial recommendations, which EPA did not do. Thus, TSS's support for making cleanup decisions based on EPA's XRF data is illusory. Similarly weak is TSS's conclusion that, despite abysmal correlation coefficients, the arsenic XRF results would not lead EPA to a meaningful number of erroneous cleanup decisions.[31] Considering the samples for which both XRF and lab data are available, 173 had an arsenic XRF result above the 39 ppm RML. But for 112 of them, the lab result was below the RML. That is, when the XRF found arsenic concentrations warranting cleanup, it was wrong nearly 65 percent of the time. The same analysis for lead reveals that an XRF indicated RML exceedance was wrong more than 16 percent of the time.[32]

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[27] Worse still, EPA's errors are even more pronounced for the properties it has notified residents need to be cleaned up. Specifically, the correlation coefficient for XRF arsenic levels results above the 39 ppm is nearly zero (0) at an astonishing low 0.04.

[28] *See* TSS Memornadum (February 12, 2013) (Exhibit B).

[29] Memorandum from Glenn Adams, TSS Chief, to Greg Harper, On-Scene Coordinator, Response to Request for TSS Review of 35th Ave. Actions (March 20, 2014) (Exhibit E).

[30] *Id.* at 2

[31] *Id.* at 3.

[32] EPA has also suggested that PRPs can cure EPA's data problems by simply resampling yards before cleaning them up. EPA's suggestion that the private sector should bear the costs of the agency's failings with duplicative effort is troubling and, regardless, does not absolve the agency of having disseminated information in violation of its IQA Guidelines.

The magnitude of differences between the XRF and lab results also reinforces that the XRF data is inaccurate and unreliable. With respect to lead, the difference between the XRF data and the lab data ranges from 0 to ***834 percent***. Even more alarming is the difference between the XRF data and the lab data for arsenic, ranging from 0.3 to ***1,825 percent***, meaning that in some instances the XRF device gave results for arsenic that were more than ***18 times*** their true value.

Furthermore, EPA's XRF data and the resulting cleanup decisions are unclear and incomplete because EPA has not told recipients of the information that the underlying data is fatally flawed. Because it does not provide this context, the agency leads the recipients of the information to believe that the XRF data is definitive and that there should be confidence in EPA's cleanup decisions. In reality, the XRF data is not fit for any use and cleanup decisions based on it are highly suspect.

Finally, EPA's cleanup decisions based on the XRF results are also biased in favor of cleaning up properties whether they need it or not. As described above, the samples for which XRF and lab results are available show that the XRF generated many false positives. But for all of these false positive results, EPA reported the erroneous XRF result to the resident and concluded that the property needed to be cleaned up. Given how unreliable the XRF arsenic and lead results are, EPA's choice to use known, false positive XRF data instead of lab data cannot be explained away as a conservative approach to a known problem. Rather, it is the choice to manufacture a problem where one does not exist.

B. The XRF data and the cleanup decisions based thereon lack utility.

Under EPA's IQA Guidelines, "utility" refers to the usefulness of the information to the intended users.[33] The intended users of the XRF data and the resulting cleanup decisions include EPA, the residents of the Site, PRPs, ATSDR, and the public. But this information is in no way useful because, as discussed above, it is so fundamentally inaccurate, unreliable, unclear, incomplete, and biased. Thus, the XRF data and the resulting cleanup decisions do not satisfy the IQA Guidelines' utility requirement.

IV. EPA's XRF data and the resulting cleanup decisions are "influential" information but fail to meet the higher applicable standard set forth in EPA's IQA Guidelines.

EPA's IQA Guidelines recognize "influential scientific, financial, or statistical information" as a special subset of information that "should be subject to a higher degree of quality."[34] Influential information is that which has a "clear and substantial impact on

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[33] EPA IQA Guidelines at 15.

[34] *Id.* at 19, 20.

important public policies or private sector decisions."[35] For such information, EPA generally intends to assure influential information's reproducibility by increasing the transparency of data sources, assumptions, methods, procedure, and rigor.[36]

The Site and EPA's decisions concerning it have a clear and substantial impact on public policies and private sector decisions and, therefore, are "influential information." This Site has been and remains a very important issue to the community, Walter Coke, the other PRPs, the State of Alabama, Birmingham, state and federal agencies, public officials, and EPA Region 4.[37] For example, the State of Alabama opposes EPA's proposal to list the Site on the NPL. On the other hand, Walter Coke understands that some in the community have formed People Against Neighborhood Industrial Contamination in part in response to the environmental conditions EPA reports to have found in the communities. The Site was also the subject of recent documentary "Toxic City,"[38] as well as serial reporting by CBS 42 under the moniker "Deadly Deception."[39] Additionally, Region 4 includes the Site in its environmental justice program.[40]

Regarding private sector decisions, the XRF data and the cleanup decisions based on that data directly impact current PRPs, additional PRPs that EPA may name in the future, and current residents. The residents—potentially hundreds of them—need to decide whether to allow EPA access to their property to replace soil. The only information residents have for making that decision is the data that EPA presents. Thus, Walter Coke expects the XRF data and EPA's misleading endorsement of it to be highly influential on residents.

As for Walter Coke and other named PRPs, EPA's blind adherence to fatally flawed data as the basis for decisions discourages companies from any prospect of future cooperation with the agency. Fundamental to almost any cooperative working relationship between an agency and a company is a mutual commitment to sound science. At the Site, EPA's treatment of the lead and arsenic XRF data reveals that, to date, EPA is not committed to sound science at the Site because science indicates that the XRF data is not

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[35] *Id.* at 19.

[36] *Id.* at 20-21.

[37] *See* EPA.GOV, http://www2.epa.gov/north-birmingham-project.

[38] *See* WIAT.COM, http://wiat.com/deadly-deception/; AL.COM, http://www.al.com/opinion/index.ssf/2014/06/toxic_city_documentary_is_a_ra.html.

[39] *See* WIAT.COM, http://wiat.com/deadly-deception/.

[40] *See* EPA.GOV, http://www2.epa.gov/north-birmingham-project/cleanup-process-north-birmingham-environmental-collaboration-project.

usable. Of course, by granting this Petition and taking corrective measures, EPA could begin to restore trust in the agency's commitment to sound science at the Site.

Despite being influential information, the XRF data and the resulting cleanup decisions fail, as shown above, to meet even basic data quality standards, let alone the higher degree of quality applicable to "influential information." In fact, given the low correlation between arsenic and lead lab and XRF results, there is essentially no chance of reproducing in a lab a dataset similar to EPA's XRF dataset. And EPA's nondisclosure to the public of both the flaws in its XRF data and whether a cleanup decision for a specific property was based on XRF or lab data show that the agency is not being transparent about its data sources, methods, and lack of rigor. Thus, EPA has failed to meet the objectivity and utility requirements applicable to all disseminated information, as well as the also-applicable, higher data quality standards for influential information.

V. Even if the XRF data and the cleanup decisions based on them are not subject to EPA's IQA guidelines, corrective measures are still warranted under EPA's basic commitment to information quality.

Even if EPA's arsenic and lead XRF data and the resulting cleanup decisions are not subject to the IQA Guidelines, *per se*, it remains EPA's policy that "all of the information it distributes meets a basic standard of information quality, and that its quality, objectivity, and integrity be scaled and appropriate to the nature and timeliness of the planned anticipated uses."[41] Thus, all information distributed by EPA—whether or not that distribution is "dissemination"—is still subject to correction as needed.

As described above, the Site, EPA's data, and any cleanup decisions are important issues to EPA, ATSDR, residents of North Birmingham, PRPs, the City of Birmingham, the State of Alabama, and others. By allowing the faulty XRF data and cleanup decisions to linger in the public domain and as a source of information for ATSDR, EPA is essentially duping these constituencies into concern or complacency, depending on their perspective and their property results. But these constituencies deserve better; they deserve an agency, data, and decision making they can trust. Thus, even under EPA's sliding scale approach to information quality for information outside of the IQA Guidelines, the XRF data and the resulting cleanup decisions simply do not measure up, and corrections are needed.

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[41] EPA IQA Guidelines at 18.

VI. Requested Relief

Corrective public communications are urgently needed to retract the disseminated XRF results and resulting cleanup decisions. In particular, EPA must act to prevent ATSDR from the embarrassment of finalizing a report based on unusable data. EPA should issue the corrective public communications in the same ways that it disseminated the XRF data and cleanup decisions—including public meetings, website postings, fact sheets, notices mailed directly to residents, and direct contact with ATSDR. The corrections should communicate that

1. EPA's XRF data was flawed,
2. The XRF data was the exclusive source of metals data for 86 percent of samples,
3. EPA incorrectly disseminated XRF data for many yards for which lab data was also available,
4. The XRF data is so flawed that it cannot be used for making cleanup decisions or relied on for any purposes, including for an ATSDR Health Consultation, and
5. That it is likely that many of the cleanup decisions EPA has made based on the XRF data are wrong, and therefore, EPA is withdrawing all such cleanup decisions for reevaluation.

Respectfully submitted this 30th day of September 2015.

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ATTORNEYS FOR WALTER COKE, INC.

Exhibit A

Health Consultation

PUBLIC COMMENT VERSION

Evaluation of Surface Soil and Garden Produce Exposures

35th AVENUE SITE

BIRMINGHAM, ALABAMA

EPA FACILITY ID: ALN000410750

JULY 22, 2015

COMMENT PERIOD ENDS: AUGUST 31, 2015

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

PUBLIC COMMENT RELEASE

Evaluation of Surface Soil and Garden Produce Exposures

35th AVENUE SITE

BIRMINGHAM, ALABAMA

EPA FACILITY ID: ALN000410750

Prepared By:

Central Branch
Division of Community Health Investigations
Agency for Toxic Substances and Disease Registry

This information is distributed solely for the purpose of predissemination public comment under applicable information quality guidelines. It has not been formally disseminated by the Agency for Toxic Substances and Disease Registry. It does not represent and should not be construed to represent any agency determination or policy.

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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
ACLPPP	Alabama Childhood Lead Poisoning Prevention Project
ADPH	Alabama Department of Public Health
ALM	Adult Lead Methodology
BaP	benzo(a)pyrene
BaP-TE	benzo(a)pyrene toxic equivalent
bgs	below ground surface
BLL	blood lead level
CCA	chromated copper arsenate
CDC	Centers for Disease Control and Prevention
CI	confidence interval
COPD	chronic obstructive pulmonary disease
CREG	cancer risk evaluation guide
CSF	cancer slope factor
CTE	central tendency exposure
CV	comparison value
DHHS	Department of Health and Human Services
EMEG	environmental media evaluation guide
IARC	International Agency for Research on Cancer
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
JCDH	Jefferson County Department of Health
LOAEL	lowest-observed-adverse-effect-level
µg/day	micrograms per day
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
MRL	minimal risk level
NBCC	Northern Birmingham Community Coalition
NHANES	National Health and Nutrition Examination Survey
NOAEL	no-observed-adverse-effect-level
PAH	polycyclic aromatic hydrocarbon
PEF	potency equivalency factor
PHC	public health consultation
PM	particulate matter

ppm	parts per million
QA/QC	quality assurance/quality control
RAL	removal action level
RBA	relative bioavailability
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RME	reasonable maximum exposure
RML	removal management level
RSE	Removal Site Evaluation
TCL	Target Compound List
TCRA	time critical removal action
US EPA	U.S. Environmental Protection Agency
XRF	X-ray fluorescence spectrometer

1. Executive Summary

Introduction

The Agency for Toxic Substances and Disease Registry's (ATSDR's) purpose is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances.

In November 2014, the United States Environmental Protection Agency (US EPA) Region 4 requested that ATSDR evaluate environmental sampling data collected for the 35th Avenue site in North Birmingham, Jefferson County, Alabama. The site includes residential properties in Collegeville, Fairmont, and Harriman Park. US EPA requested that ATSDR focus its evaluation on arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) found in residential surface soil and homegrown garden produce in these communities.

US EPA provided ATSDR with sampling results for surface soil samples collected from November 2012 through January 2015, and homegrown garden produce samples collected in July 2013. The purpose of this public health consultation (PHC) is to evaluate the public health significance of exposures to contaminants in residential surface soil and homegrown garden produce in these communities.

Conclusions

Following its review of the 35th Avenue residential surface soil and homegrown garden produce data, ATSDR reached three health-based conclusions.

Conclusion 1

ATSDR concludes that past and current exposure to arsenic found in surface soil of some residential yards could harm people's health. Children are especially at risk.

Basis for Decision 1

- About 20 of over 1,100 tested properties in the past and 3 properties currently have soil arsenic levels of public health concern for children who intentionally eat soil (which leads to a higher than normal soil intake) for acute (short-term) exposures. These children may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Also, the maximum levels of arsenic at two properties in the past and one property currently were and are of concern for short-term exposures for all children, even those who do not intentionally eat soil. Children who frequently engage in activities like digging with shovels and other tools, and playing with toys (such as toy trucks and action figures) on the ground surface at these properties are especially at risk.

- For chronic (long-term) exposures, about 10 of over 1,100 tested properties in the past and 2 properties currently have soil arsenic levels of potential public health for children for noncancerous dermal health effects (e.g., hyperpigmentation and hyperkeratosis). Children who engage in activities like digging with shovels and playing with toys on the ground surface every day for longer than a year are at risk, especially at properties with gardens and play areas with bare soil.
- About 66 of over 1,100 tested properties in the past and 30 properties currently have soil arsenic levels that increase the risk of cancer by 1 in 10,000 people, which ATSDR considers a level of concern for lifetime cancer risk. Overall, ATSDR considers arsenic soil exposures at most properties to represent a low cancer risk.
- Although ingestion of arsenic in homegrown garden produce alone is not of health concern, exposure to the maximum arsenic level found in the garden produce may add to the health risk for those also exposed to elevated levels of arsenic in surface soil.

Conclusion 2

ATSDR concludes that past and current exposure to lead found in surface soil of some residential yards could harm people’s health. Swallowing this lead-contaminated soil, along with lead from other sources such as lead paint, could cause harmful health effects, especially in children and in the developing fetus of pregnant women.

Basis for Decision 2

- Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects. ATSDR notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
- There are some residential properties with high levels of lead in surface soil, indicating the potential for elevating blood lead levels (BLLs) in children who live at or visit these properties. Children who intentionally eat soil are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Other indoor and outdoor sources of lead may result in elevating BLLs even further. Also, multiple factors that have been

associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race). Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.

- ATSDR reviewed available BLL data from two sources.
    1. In July 2013, the Jefferson County Department of Health conducted a limited site-specific BLL screening event of 44 participants (1–70 years of age). Thirteen participants were children 1–5 years of age, although two of these children did not live within the site boundaries. No BLLs exceeded the current 5 micrograms per deciliter (µg/dL) reference level[1] for children 1–5 years of age. Overall, 15 of the 44 participants (34%) did not actually live within the boundaries of the site.
    2. The site lies in ZIP code 35207. The Alabama Department of Public Health provided ATSDR with 2010–2014 BLL data for 560 children ≤ 21 years of age living within this ZIP code. This ZIP-code review indicated 25 children 1–5 and 6–11 years of age had BLLs at and above 5 µg/dL. However, the ZIP-code level BLL data may not necessarily be representative of the site area.
- Although ingestion of lead in garden produce is not of health concern, it will increase the risk of harm with increasing soil lead concentrations. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

Conclusion 3

ATSDR concludes that long-term exposure (i.e., many years) to PAHs found in the surface soil of some residential yards is at a level of concern for lifetime cancer risk.

Basis for Decision 3

- Several PAHs have been linked with tumors in laboratory animals when they breathed, ate, or had long periods of skin exposure to

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[1] This reference level is based on the highest 2.5% of the U.S. population of children ages 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES). NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. As part of the examination component, blood, urine, and other samples are collected and analyzed for various chemicals. The NHANES test population is selected to be representative of the civilian, noninstitutionalized population of the United States.

these substances. Benzo(a)pyrene (BaP) has been linked with stomach cancer and dibenz(ah)anthracene with lung cancer.

- Seven PAHs were detected in residential surface soil. For six of these PAHs, ATSDR calculated a benzo(a)pyrene toxic equivalent (BaP TE) value for each sample. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. The BaP TE value is the sum of these six PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP. About 125 of over 1,100 tested properties in the past and 64 properties currently have soil BaP TE levels that increase the risk of cancer by 1 in 10,000 people, which ATSDR considers a level of concern for lifetime cancer risk.
- For dibenz(ah)anthracene, 14 of over 1,100 tested properties in the past and 2 properties currently have soil levels that increase the risk of cancer by 1 in 10,000 people.
- Overall, ATSDR considers long-term PAH soil exposures at most residential properties to represent a low cancer risk.

Next Steps

Following its review of available information, ATSDR recommends

1. Parents monitor their children's behavior while playing outdoors and prevent their children from intentionally or inadvertently eating soil.
2. Residents take measures to reduce exposures to residential soil and to protect themselves, their families, and visitors (see Appendix C).
3. Parents follow the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012].
4. Residents take steps to reduce lead uptake (see Appendix D).
5. Residents take measures to reduce exposure to lead from other possible sources (see Table 11B, Appendix B, and Appendix E).
6. US EPA test the bioavailability of metals (arsenic and lead) in the soil.
7. US EPA continue with its plans to remediate additional properties to reduce arsenic, lead, and PAH levels in residential surface soil.

For More Information

Call ATSDR at 1-800-CDC-INFO and ask for information on the 35th Avenue site.

2. Statement of Issues

The United States Environmental Protection Agency (US EPA) Region 4 requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate the public health significance of environmental sampling data collected in North Birmingham, Jefferson County, Alabama. In 2012 and 2013, US EPA sampled residential properties[2] including areas of Collegeville, Fairmont, and Harriman Park. These residential properties are now part of US EPA's 35th Avenue site (see Figure 1A, Appendix A).

Specifically, US EPA requested ATSDR focus on exposures to arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) found in

- Surface soil, and
- Homegrown garden produce.

Arsenic, lead, and PAHs were found in surface soil at levels that exceeded US EPA Region 4 residential removal management levels (RMLs). In some instances, garden plants can take up soil contaminants into the root or other edible portions of the plant. The purpose of this public health consultation (PHC) is to evaluate the public health significance of exposures to contaminants in residential surface soil and homegrown garden produce in these communities.

3. Background

3.1. Site Description

In North Birmingham, residential properties in areas of Collegeville, Fairmont, and Harriman Park are a large part of US EPA's 35th Avenue site. Churches, schools, and parks with recreational activities are also a part of the site. Other land use within the site boundaries and surrounding area varies between heavy industry, light industry, commercial, retail, and rail lines [USEPA 2013a].

Residential dwellings in the Collegeville neighborhood were present as late as 1929. The Harriman Park neighborhood was constructed in the early 1950s. Construction of residential dwellings in the Fairmont neighborhood appear to have begun as late as 1951 and continued through the late 1970s [OTIE 2012; OTIE 2013b]. Surface topography in the area ranges from very flat (Collegeville) to hilly (Fairmont). Numerous creeks, drainage channels, and storm water drain pipe systems exist in the site area. Portions of Collegeville are prone to periodic flooding and are located within a 100-year floodplain [USEPA 2013a].

The Birmingham area of Alabama has been heavily industrialized for decades. The site area is surrounded by industrial facilities historically and currently associated with coke and chemical manufacturing. Several manufacturing facilities in North Birmingham have operated since the early 1900s [USEPA 2015a].

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[2] "Residential properties" refer to parcels of land in the study area including single-family homes, multi-unit housing, churches, schools, and recreational parks. Residential properties also include parcels of land reclaimed by the City of Birmingham due to lien or flooding. These reclaimed parcels are currently empty lots with no structures or have abandoned structures but are still appropriate for residential use.

3.2. Site Activities

This section provides a brief discussion of a few site activities; it is not intended to provide a complete history of actions that have occurred at the 35th Avenue site.

Water Coke is adjacent to all three communities (see Figure 1A, Appendix A). Historic or ongoing activities at Walter Coke include manufacturing of coke, manufacturing of toluene sulfonyl acid, production of pig iron from iron ore, manufacturing of mineral fibers (mineral wool), and a biological treatment facility and sewers designed to treat wastewater generated at the facility [CH2MHill 2005]. The US EPA Region 4 Resource Conservation and Recovery Act (RCRA) Division has been involved with the Walter Coke facility for over 20 years. This includes sampling and analysis activities to identify the nature and extent of contamination in surface soil.

Under US EPA oversight, Walter Coke collected soil samples from 78 residential properties located in Collegeville, Fairmont, and Harriman Park in 2005 and 2009 [EPA 2014a]. In 2013, ATSDR released a PHC that evaluated arsenic and PAH levels in surface soil from these two sampling events. The 2013 PHC recommended remediation at properties with the highest contaminant concentrations to decrease soil exposures (see http://www.atsdr.cdc.gov/HAC/pha/WalterCokeInc/WalterCokeIncHC(Final)08012013_508.pdf). As a result of those sampling events, Walter Coke agreed to remediate several offsite properties.

In addition to the soil data evaluated in its 2013 PHC, ATSDR also evaluated US EPA and Jefferson County Department of Health (JCDH) air sampling results from 2005–2006, 2009, and 2011–2012. Air samples were collected in the Collegeville, Fairmont, and Harriman Park communities as well as in Providence (a rural location near Birmingham for background comparisons). The samples were tested for many chemicals and particulate matter (PM). ATSDR reviewed the sample results to see whether any chemical levels in air were high enough to cause health problems for people who live or work in the community (see http://www.atsdr.cdc.gov/HAC/pha/NorthBirminghamAirSite/35th%20Avenue%20Site_PHA_Final_04-21-2015_508.pdf). ATSDR recommended JCDH continue checking the PM levels in air because people who have asthma, chronic obstructive pulmonary disease (COPD), and heart disease may cough or have trouble breathing when they breathe PM.

On July 18 and July 23, 2013, JCDH conducted blood lead level (BLL) screening events for the 35th Avenue community. Of the 44 participants (1–70 years of age), 42 were children under 19 years of age, with 13 being 1–5 years of age [JCDH 2013]. No BLLs exceeded 5 micrograms per deciliter (µg/dL). However, 15 of the 44 participants did not actually live within the boundaries of the site [JCDH 2013]. Therefore, these results do not likely represent BLLs for the general site population.

In 2012 and 2013, US EPA conducted soil sampling at the 35th Avenue site in areas of Collegeville, Fairmont, and Harriman Park. Based on the results, US EPA proposed a time critical removal action (TCRA), which includes three phases. For each phase, US EPA developed site-specific soil removal action levels (RALs) for arsenic, lead, and benzo(a)pyrene aimed to reduce exposure risks for community members living on properties with the highest levels of soil contamination.

- **Phase 1**: US EPA removed soil at approximately 50 properties that exceeded one or more Phase 1 RAL. Removal activities began in February 2014 and were substantially[3] complete in August 2014.
- **Phase 2**: US EPA removed soil at over 35 properties that exceeded one or more Phase 2 RAL *and* had children or pregnant women, or both, living on the property. This phase was substantially complete in March 2015.
- **Phase 3**: US EPA is removing soil at over 30 properties that exceed one or more Phase 3 RAL. Soil removal activities are expected to be substantially complete this summer.

In general, TCRA soil removal activities included inventorying the property, removing impediments to excavation efforts (like plants, grasses, utilities, and fences), excavating contaminated soil, backfilling with clean soil, replacing or repairing damaged items (like piping and fences), and re-establishing vegetation. US EPA is currently determining its options toward future phases of removal action.

As part of its regional Superfund Reuse Initiative, US EPA Region 4 sponsored the formation of the Northern Birmingham Community Coalition (NBCC) to plan for future revitalization of Northern Birmingham communities, which include the Collegeville, Fairmont, and Harriman Park neighborhoods. The Coalition includes neighborhood representatives as well as business, faith-based, academic and non-profit groups, community leaders and government agencies. The NBCC has been holding monthly meetings since March 2013 and has identified priorities for further exploration including [EPA 2014a]:

- Increasing access to health care and health facilities to improve health outcomes.
- Promoting commercial revitalization with a particular focus on access to grocery stores and affordable, healthy food, and neighborhood-oriented shopping and Service stations.
- Improving housing conditions, with a particular focus on rehab of existing housing and stemming housing demolition.

Currently, the NBCC is in the process of reviewing and revising their action plan. Additional details are available at http://www2.epa.gov/north-birmingham-project.

3.3. Demographic Statistics

Using 2010 Census of Population and Housing data and an area-proportion spatial analysis technique, ATSDR calculated that 3,585 persons reside within the boundaries of the 35th Avenue site [US Census Bureau 2010a]. Of these, about 98% are black. Within the site's boundary, approximately 13% are age 65 and older and 16% are children 6 years or younger. Figure 2A, Appendix A, provides additional demographic statistics.

4. Exposure Pathway Evaluation

To determine whether people are 1) now exposed to contaminants or 2) were exposed in the past, ATSDR examines the path between a contaminant and a person or group of people who could be exposed. Completed exposure pathways have five required elements. ATSDR evaluates a pathway to

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[3] US EPA continues to respond to community concerns regarding its removal activities. For example, if the grass did not take following a yard's removal activities, the agency might plant new grass in that area.

determine whether all five factors are present. Each of these five factors or elements must be present for a person to be exposed to a contaminant:

1. A contamination source,
2. Transport through an environmental medium,
3. An exposure point,
4. A route to human exposure, and
5. People.

For the 35th Avenue site, ATSDR considers exposures to surface soil and homegrown garden produce to be completed exposure pathways.

Surface soil at the 35th Avenue site could be impacted by aerial deposition from facility emissions in the area (chemicals moving as wind-blown particulates and as soot, and landing on the soil), as well as through surface water runoff from these facilities and flooding. Because many of the homes in the area were built before 1960, they may contain heavily leaded paint. Some homes built as recently as 1978 may also contain lead paint. Deteriorating lead paint from window frames, the outside of homes, or other surfaces, could enter the soil. Some homeowners used leftover product from area facilities in their yards as soil fill material.

Exposure to contaminants in surface soil occurs primarily through dermal contact. In addition, people might accidentally ingest surface soil, as well as dust generated from disturbing the soil. Preschool age children tend to swallow more soil than do any other age group because they have more contact with soil through their play activities and they tend to exhibit mouthing of objects and hand-to-mouth behavior. Children in elementary school, teenagers, and adults tend to swallow much smaller amounts of soil. Of note, some children eat non-food items like soil. Groups that are at an increased risk for this behavior are children 1–3 years of age. The amount of vegetative or other soil cover in an area, the amount of time spent outdoors, and weather conditions also influence people’s exposure to soil.

For this PHC, ATSDR considers two exposure scenarios: past and current exposures to arsenic, lead, and PAHs in surface soil. In general, ATSDR considers “past exposure” to be exposure to the chemical levels found in surface soil prior to removal activities and “current exposure” to be exposure to the chemical levels that remain at the site after the TCRA.

Homegrown garden produce could be impacted by aerial deposition (chemicals landing on the surface of the produce) and root uptake (movement of the chemicals from the soil into the produce). Garden produce could also be impacted by "direct soil contact" as some heavy fruits (tomatoes) and leafy vegetables (greens) lay on the surface of the soil whereby rain events or garden activity can cause soil particles to adhere to the surface of the produce. Exposure occurs through ingestion of soil contaminants on or in the homegrown garden produce.

5. Environmental Data

During the public health assessment process, ATSDR reviews environmental data and evaluates these data in the context of its site-specific exposure pathway assessment. From November 2012 until June 2013, US EPA conducted environmental sampling activities during a Removal Site Evaluation (RSE) where access was granted to over 1,100 of the approximately 2,000 parcels in the 35th Avenue site study area. Additional sampling activities occurred in conjunction with the TCRA. This PHC focuses on surface soil and homegrown garden produce sampling conducted from November 2012 through January 2015 [USEPA 2015B].

5.1. Surface Soil Sampling Design and Analysis

For the purpose of this PHC, ATSDR calls each distinct composite sampling area on a residential property a "grid". The removal report states the exact number of aliquots per composite sample was determined in the field based on sampling area size but did not exceed five points [OTIE 2013b]. Most of the 5-point composite surface soil samples US EPA collected were 0–4 inches below ground surface (bgs), although some (less than 10%) were 0–6 inches bgs. US EPA collected composite samples based on the parcel lot size as follows [OTIE 2012, 2013b]:

- For residential properties with a total parcel lot size equal to or less than (≤) 5,000 square feet, two composite samples were collected—one in the front yard and one back yard. If the property had a substantial side yard, then one composite soil sample was also collected from the side yard. Aliquots were collected away from drip lines and burn areas in a five dice configuration (each of the four corners and the center).
- For residential properties with a total parcel lot size greater than (>) 5,000 square feet and ≤ ¼-acre, the property was divided into two roughly equal surface area grids and a composite sample collected from each grid. If the property had a substantial side yard, then one composite soil sample was also collected from the side yard (primarily corner lots). Aliquots were collected away from drip lines and burn areas with reasonably equal spacing between aliquots.
- Residential properties over ¼-acre in parcel lot size were divided into ¼-acre sections, with each section representing a grid. When dividing any such property with a substantial side yard, one composite soil sample was also collected from the side yard. Aliquots were collected away including drip lines and burn areas in a five dice configuration, if possible, with reasonably equal spacing between aliquots.

In addition, US EPA collected grab surface soil samples from locations with active play sets and from low-lying areas. A 3-point composite surface soil sample was collected from distinct vegetable gardens. Quality assurance/quality control (QA/QC) samples, including field duplicates, rinsate blanks, field blanks, and preservative blanks, were also collected. Samples were not collected under paved areas or under stationary fixed structures, such as houses, sheds, buildings, concrete pads, and driveways.

Information identifying the location, sample point, date, and time were recorded for all samples. If the sample's moisture content was greater than 20% (as measured with a portable soil moisture meter), the sample was dried before sieving or analysis was performed. Once the sample was dried, a portion of samples (about 60%) were sieved using a 2 millimeter sieve [OTIE 2012, 2013b].

US EPA's primary focus was to collect surface soil samples to assess whether PAHs and RCRA 8 metals[4] were present at concentrations above RMLs. The samples were submitted to a laboratory for Target Compound List (TCL) PAH analysis. PAH laboratory analysis was conducted on the unsieved portion of the samples. All soil samples were first field screened for RCRA 8 metals using X-ray fluorescence

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[4] RCRA 8 metals are arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.

spectrometer (XRF) and then about 10% of the samples were split and submitted to the laboratory for RCRA 8 metals analysis. Due to the nonhomogeneous nature of the soils present in the study area, US EPA used the bin approach to identify which samples were sent to the laboratory [OTIE 2013b]. RCRA metals were analyzed in the field and laboratory from both the sieved and unsieved portions of the samples [OTIE 2012, 2013b].

5.2. Homegrown Garden Produce Sampling Design and Analysis

On July 23 and 24, 2013, US EPA collected vegetable samples for laboratory analysis from residential gardens. US EPA intended on sampling produce from 10 gardens but only about five gardens had enough vegetables for analysis [OTIE 2013a].

A total of 20 vegetable tissue samples, including two field duplicate samples, were collected from the gardens. Both washed and unwashed samples of tomatoes, cucumbers, collard greens, and zucchinis were submitted for arsenic, lead, and PAH laboratory analysis. Washed samples of green onion, okra, and pepper were submitted for arsenic and lead laboratory analysis [OTIE 2013a].

6. Data Screening

The screening analysis process enables ATSDR to identify chemicals that might need closer evaluation. The screening process compares measured chemical concentrations with health-based comparison values (CVs) [ATSDR 2005].

A health-based CV is an estimate of daily human exposure to a chemical that is not likely to result in harmful health effects over a specified exposure duration. ATSDR has developed CVs for specific media (e.g., air, water, and soil). ATSDR CVs are generally available for three specified exposure periods: acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) [ATSDR 2005].

Some of the CVs and health guidelines ATSDR scientists use include ATSDR's cancer risk evaluation guides (CREGs), environmental media evaluation guides (EMEGs), and minimal risk levels (MRLs) (see Appendix F). Health-based CVs and health guidelines, as well as all other health-based screening criteria, are conservative levels of protection—they are not thresholds of toxicity. Although concentrations at or below a CV represent low or no risk, concentrations above a CV are not necessarily harmful. To ensure that they will protect even the most sensitive populations (e.g., children or the elderly), CVs are designed intentionally to be much lower, usually by two or three orders of magnitude,[5] than the corresponding no-observed-adverse-effect-levels (NOAELs) or lowest-observed-adverse-effect-levels (LOAELs) on which the CVs are based. Most NOAELs and LOAELs are established in laboratory animals; relatively few are derived from epidemiologic (i.e., chiefly worker) studies. All ATSDR health-based CVs

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[5] "Order of magnitude" refers to an estimate of size or magnitude expressed as a power of ten. An increase of one order of magnitude is the same as multiplying a quantity by 10, an increase of two orders of magnitude equals multiplication by 100, an increase of three orders of magnitude is equivalent of multiplying by 1000, and so on. Likewise, a decrease of one order of magnitude is the same as multiplying a quantity by 0.1 (or dividing by 10), a decrease of two orders of magnitude is the equivalent of multiplying by 0.01 (or dividing by 100), and so on.

are nonenforceable—they are for screening purposes and are only used to determine the chemicals that require further evaluation.

For this PHC, US EPA asked ATSDR to focus its health evaluation on arsenic, lead, and PAH levels in residential surface soil and homegrown garden produce. The following text provides information about ATSDR CVs for these environmental media and compounds.

- No ATSDR health-based CVs exist for screening chemical levels in garden produce.
- Arsenic surface soil levels are screened using the ATSDR chronic child EMEG[6] of 15 parts per million (ppm).
- No ATSDR health-based CV exists for screening lead in surface soil because there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
- Seven PAHs were detected in surface soil. No ATSDR health-based CV exists for the PAH dibenz(ah)anthracene. The other six PAHs are screened using ATSDR's benzo(a)pyrene (BaP) CREG of 0.096 ppm and benzo(a)pyrene toxic equivalent (BaP TE) values. The BaP TE value is the sum of the different PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP; that is, the BaP TE equals the sum of the individual PAH concentrations multiplied by their respective potency equivalency factor (PEF). Those specific PAHs and PEFs are in Table 1.

Table 1. Potency Equivalency Factors

Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Indeno(123-cd)pyrene	0.1

Source: Cal EPA 2005.

6.1. Surface Soil Results

In this PHC, ATSDR considers both past and current exposures to arsenic, lead, and PAHs in surface soil, which is defined by the agency for this document as 0–6 bgs. ATSDR decided that each grid was a separate exposure point. For descriptive statistics of each chemical, ATSDR provided information based on both grids and properties.

- Grids: For its metals screening analysis of each grid, ATSDR selected the maximum composite sample value to represent that grid regardless of whether that maximum value was from a field

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[6] The CREG for arsenic in soil (0.47 ppm) is below background levels, so the recommended soil CV is the EMEG (15 ppm) [ATSDR 2013].

sample or a field duplicate, from a sample that was sieved or unsieved, or from an XRF measurement or laboratory analysis. For PAHs, ATSDR selected the maximum composite sample value to represent that grid regardless of whether that maximum value was from a field sample or a field duplicate. ATSDR notes PAH analyses were completed in the laboratory on unsieved samples only.

- Properties: For each property, ATSDR selected the grid with the maximum value to represent that property.

Tables 2B–5B, Appendix B, provide descriptive statistics[7] for arsenic, lead, BaP TE, and dibenz(ah)anthracene. ATSDR notes that changes in descriptive statistics when comparing the past and current exposure scenarios are dependent on several factors including that 1) the TCRA only targeted properties with the highest levels of contamination, 2) the RALs chosen for each chemical varied for each phase of the TCRA, and 3) some property owners allowed access for sampling activities, but then denied access for removal activities.

In Table 2B, Appendix B, ATSDR provides descriptive statistics for arsenic in surface soil. Overall, 1,971 grids in the past had a concentration exceeding arsenic's chronic child EMEG. Because of US EPA removal actions, arsenic levels in surface soil are no longer above the arsenic chronic child EMEG at 195 of these grids.

In Table 3B, Appendix B, ATSDR provides descriptive statistics for lead in surface soil. However, ATSDR could not provide comparisons of site-specific concentrations to a health-based screening value. As stated previously, no ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures.

For each grid sampled, ATSDR calculated a BaP TE value by adding the sum of six PAHs detected in the surface soil sample with their concentrations adjusted for their toxicity relative to BaP. In Table 4B, Appendix B, ATSDR provides descriptive statistics for BaP TE in surface soil. Overall, 2,424 grids in the past had a concentration exceeding the ATSDR BaP CREG of 0.096 ppm. Because of US EPA removal actions, BAP TE levels in surface soil are no longer above the BaP CREG at 214 of these grids.

In Table 5B, Appendix B, ATSDR provides descriptive statistics for dibenz(ah)anthracene in soil. However, ATSDR could not provide comparisons of site-specific concentrations to a health-based screening value. As stated previously, no ATSDR health-based CV exists for screening dibenz(ah)anthracene in soil.

ATSDR retains for public health evaluation those chemicals exceeding CVs as well as those chemicals with no CVs. Therefore, further evaluation is needed to determine whether arsenic, lead, and PAH exposures were or are of public health concern at the 35th Avenue site.

6.2. Garden Produce Results

PAHs were not detected in any of the 20 vegetable samples. Arsenic was detected in only one sample, an unwashed collard green sample at a concentration of 0.069 milligrams per kilogram (mg/kg). Lead was detected in four garden produce samples: 0.063 mg/kg (unwashed cucumber), 0.16 mg/kg (unwashed collard green), 0.43 mg/kg (unwashed tomato), and 0.57 mg/kg (washed green onion) [OTIE 2013a]. ATSDR could not provide comparisons of site-specific concentrations to health-based screening

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[7] Table 1B, Appendix B, provides a definition of the statistical terms used in Tables 2B–5B.

values. As stated previously, no ATSDR health-based CVs exist for screening chemical levels in garden produce.

7. Public Health Evaluation

In this section, ATSDR addresses the question of whether exposure to arsenic, lead, and PAHs at the concentrations detected would result in adverse health effects. While the relative toxicity of a chemical is important, the human body's response to a chemical exposure is determined by several additional factors. These factors include

- the concentration (how much) of the chemical the person was exposed to,
- the amount of time the person was exposed (how long), and
- the way the person was exposed (through breathing, eating, drinking, or direct contact with something containing the chemical).

Lifestyle factors (for example, occupation and personal habits) have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any harmful health effects the individual may suffer from exposure.

As part of its evaluation, ATSDR typically derives exposure contaminant doses for children and adults. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (like soil). Exposure doses help ATSDR determine the likelihood that exposure to a chemical might be associated with harmful health effects.

Two key steps in ATSDR's analysis involve (1) comparing the estimated site-specific exposure doses with observed effect levels reported in critical studies and (2) carefully considering study parameters in the context of site exposures [ATSDR 2005]. This analysis requires the examination and interpretation of reliable substance-specific health effects data. This includes reviews of epidemiologic (human) and experimental (animal) studies. These studies are summarized in ATSDR's chemical-specific toxicological profiles. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicological properties. When evaluating a site, ATSDR health assessors also review more recently released studies in the scientific literature to ensure that our public health evaluations are based on the most current scientific knowledge.

Overall, assessing the relevance of available epidemiologic and experimental studies with respect to site-specific exposures requires both technical expertise and professional judgment. Because of uncertainties regarding exposure conditions and the harmful effects associated with environmental levels of chemical exposure, definitive answers about whether health effects will or will not occur are not feasible. However, providing a framework that puts site-specific exposures and the potential for harm in perspective is possible [ATSDR 2005].

In the following section, ATSDR summarizes the relevant epidemiologic and experimental information for arsenic, lead, and PAHs. ATSDR then provides its public health evaluation of each chemical.

7.1. Arsenic

Arsenic, a naturally occurring element, is widely distributed in the Earth's crust, which contains about 3.4 ppm arsenic [Wedepohl 1991]. Most arsenic compounds have no smell or distinctive taste. Although elemental arsenic sometimes occurs naturally, arsenic is usually found in the environment in two forms—inorganic (arsenic combined with oxygen, chlorine, and sulfur) and organic (arsenic combined with carbon and hydrogen). Sometimes, the specific form of arsenic present in the environment is not determined. Therefore, what form of arsenic a person may be exposed to is not always known.

Most simple organic forms of arsenic are less harmful than the inorganic forms [ATSDR 2007a]. Once in the environment, arsenic cannot be destroyed; it can only change forms or become attached to or separated from particles (e.g., by reacting with oxygen or by the action of bacteria in soil). Some forms of arsenic may be so tightly attached to particles or embedded in minerals that they are not taken up by plants and animals.

Arsenic is released to the environment through natural sources such as wind-blown soil and volcanic eruptions. However, anthropogenic (man-made) sources of arsenic release much higher amounts of arsenic than natural sources. These anthropogenic sources include nonferrous metal mining and smelting, pesticide application, coal combustion, wood combustion, and waste incineration. About 90% of all commercially produced arsenic is used to pressure-treat wood [ATSDR 2007a]. In the past, arsenic was widely used as a pesticide; in fact, some organic arsenic compounds are still used in pesticides. US EPA states that pesticide manufacturers have voluntarily phased out certain chromated copper arsenate (CCA) use for wood products around the home and in children's play areas; effective December 31, 2003, no wood treater or manufacturer may treat wood with CCA for residential uses, with certain exceptions [USEPA 2011a].

People may be exposed through incidentally ingesting soil containing arsenic. Arsenic concentrations for uncontaminated soils generally range from 1–40 ppm, with a mean of 5 ppm [ATSDR 2007a]. Arsenic concentrations in soils from various countries range from 0.1 to 50 ppm and can vary widely among geographic regions. The US Geological Survey reports a mean of 7.2 ppm and a range of less than 0.1–97 ppm in the United States [Shacklette and Boerngen 1984]. Higher arsenic levels may be found in the vicinity of arsenic-rich geological deposits, some mining and smelting sites, or agricultural areas where arsenic pesticides had been applied in the past.

People may be exposed through ingestion of garden produce containing arsenic. Garden plants grown in arsenic-contaminated soils take up small amounts of arsenic in their roots [Thorton 1994; Samsøe-Petersen et al. 2002; ATSDR 2007a]. In these studies, the arsenic concentrations in the plant roots were a small fraction of arsenic concentrations in the soils and the arsenic concentrations in the plants did not exceed regulatory standards for food items [Thorton 1994; Stillwell 2002]. Several studies also indicated that the plants took in more arsenic from air (and atmospheric deposition) than from uptake through their roots from soil [Larsen et al. 1992; Thorton 1994; Stillwell 2002]. Arsenic in leafy vegetables (kale) was by direct atmospheric deposition, while arsenic in the root crops (potatoes and carrots) was a result of both soil uptake and atmospheric deposition [Larsen et al. 1992]. US dietary intake of inorganic arsenic has been estimated to range from 1 to 20 micrograms per day (µg/day), with a mean of 3.2 µg/day; these estimates of inorganic arsenic intakes are based on measured inorganic arsenic concentrations from a market basket survey [Schoof et al. 1999a, 1999b].

Ingestion of arsenic-contaminated soil and garden produce is one way that arsenic can enter the body. Dermal exposure to arsenic is usually not of concern because only a small amount will pass through skin and into the body (4.5% of inorganic arsenic in soil) [Wester et al. 1993]. The metabolism of inorganic arsenic has been extensively studied in humans and animals. Several studies in humans indicate that arsenic is well absorbed across the gastrointestinal tract (approximately 95% absorption for inorganic arsenic compounds and 75–85% for organic arsenic compounds) [Bettley and O'Shea 1975; Buchet et al. 1981; Marafante et al. 1987; Zheng et al. 2002]. Once in the body, the liver changes (i.e., through methylation) some of the inorganic arsenic to less harmful organic forms that are more readily excreted in urine. In addition, inorganic arsenic is also directly excreted in the urine. Most forms of organic arsenic appear to undergo little metabolism. It is estimated that more than 75% of the absorbed arsenic dose is excreted in urine [Marcus and Rispin 1988]. Studies have shown that 45–85% of arsenic is eliminated within one to three days [Apostoli et al. 1999; Buchet et al. 1981; Crecelius 1977; Tam et al. 1979]. However, there appears to be an upper-dose limit to this mechanism working successfully to reduce arsenic toxicity [ATSDR 2007a].

As noted above, water-soluble forms of inorganic arsenic are well absorbed. Ingesting less soluble forms of arsenic results in reduced absorption. Studies in laboratory animals show that arsenic in soil is only one-half to one-tenth as bioavailable as soluble arsenic forms [Casteel et al. 1997; Freeman et al. 1993; Freeman et al. 1995; Groen et al. 1994; Rodriguez et al. 1999]. In one study, approximately 80% of the arsenic from ingested soil was eliminated in the feces compared with 50% of the soluble oral dose [Freeman et al. 1993]. The bioavailability of arsenic in soil may be reduced due to low solubility and inaccessibility [Davis et al. 1992]. Most of the bioavailable arsenic in water and soil is expected to be present as inorganic arsenic (trivalent arsenic and pentavalent arsenic, specifically) [Health Canada 1993]. US EPA conducted an analysis and external independent peer review of arsenic's relative bioavailability (RBA) in soil, and concluded that [USEPA 2012a, 2012b]

1. available research information suggests that an RBA of arsenic in soils can be expected to be less than 100%,
2. the upper percentile of US data results in a default RBA arsenic in soil value of 60%, and
3. the default RBA for arsenic in soils should only be used if site-specific assessments for arsenic RBA are not feasible.

ATSDR's acute oral minimal risk level[8] (MRL) of 0.005 milligrams per kilogram per day (mg/kg/day) is based on a study in which 220 people in Japan were exposed to arsenic contaminated soy sauce for a 2–3 week period. The dose was estimated to be 0.05 mg/kg/day*,* which is considered the LOAEL. Facial edema and gastrointestinal symptoms (nausea, vomiting, and diarrhea) were considered to be the critical effects seen at this dose [Mizuta et al. 1956]. The MRL is further supported by the case of a man and woman in upstate New York who experienced gastrointestinal symptoms after drinking arsenic-tainted water at an estimated dose of 0.05 mg/kg/day [Franzblau and Lilis 1989].

The chronic oral MRL (0.0003 mg/kg/day) is based on a study in which a large number of farmers (both male and female) were exposed to high levels of arsenic in well water in Taiwan. US EPA's oral reference dose (RfD) is also 0.0003 mg/kg/day [USEPA 2008]. A clear dose-response relationship was observed for characteristic skin lesions. A control group consisting of 17,000 people was exposed to 0.0008 mg/kg/day and did not experience adverse health effects. This is considered to be the NOAEL. Hyperpigmentation and keratosis of the skin were reported in farmers exposed to 0.014 mg/kg/day (less

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[8] The acute oral MRL is considered provisional because it is based on a serious LOAEL.

serious LOAEL). Those exposed to 0.038–0.065 mg/kg/day experienced an increased incidence of dermal lesions [Tseng et al. 1968; Tseng 1977]. The MRL is supported by a number of well-conducted epidemiological studies that identify reliable NOAELs and LOAELs for dermal effects [Borgoño and Greiber 1972; Cebrían et al. 1983; Guha Mazumder et al. 1988; Haque et al. 2003; Harrington et al. 1978; USEPA 1981; Valentine et al. 1985; Zaldívar 1974]. Collectively, these studies indicate that the threshold dose for dermal effects (ex., hyperpigmentation and hyperkeratosis) is approximately 0.002 mg/kg/day.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and US EPA have all determined that inorganic arsenic is carcinogenic to humans. There is convincing evidence from a large number of epidemiological studies and case reports that ingestion of inorganic arsenic increases the risk of developing skin cancer [Alain et al. 1993; Beane Freeman et al. 2004; Bickley and Papa 1989; Cebrián et al. 1983; Chen et al. 2003; Haupert et al. 1996; Hsueh et al. 1995; Lewis et al. 1999; Lüchtrath 1983; Mitra et al. 2004; Morris et al. 1974; Sommers and McManus 1953; Tay and Seah 1975; Tsai et al. 1998; Tsai et al. 1999; Tseng 1977; Tseng et al. 1968; Zaldívar 1974; Zaldívar et al. 1981]. A report by the National Research Council suggests that the risks calculated based on increases in incidence of lung and bladder cancers may be greater than those calculated based on incidences of skin cancer [NRC 2001]. In 2010, US EPA proposed a revised cancer slope factor (CSF) for inorganic arsenic based on a review of the scientific basis supporting the human health cancer hazard and dose-response assessment of inorganic arsenic [USEPA 2010].

For this PHC, ATSDR derived exposure doses for community members exposed to arsenic in soil (see Exhibit 1).

Exhibit 1: Exposure Dose Equation for Ingestion of Soil

$$\mathbf{D = \frac{C \times IR \times EF \times AF \times CF}{BW}}$$

where,

D = exposure dose in milligrams per kilogram per day (mg/kg/day)
C = chemical concentration in milligrams per kilogram (mg/kg)
IR = intake rate in milligrams per day (mg/day)
EF = exposure factor (unitless)
AF = bioavailability factor
CF = conversion factor, 1×10^{-6} kilograms/milligram (kg/mg)
BW = body weight in kilograms (kg)

As part of its evaluation, ATSDR also calculated cancer risk estimates using the US EPA arsenic oral CSF of 1.5 $(\text{mg/kg/day})^{-1}$. Under quantitative cancer risk assessment methodology, cancer risk estimates are expressed as a probability (see Exhibit 2).

Exhibit 2: Cancer Risk Equation

Age-Specific Cancer Risk = D × CSF × (ED / 78)

where,

D = age-specific exposure dose in milligrams per kilogram per day (mg/kg/day)
CFS = cancer slope factor in $(mg/kg/day)^{-1}$
ED = age-specific exposure duration in years

Cancer risk estimates are expressed as the proportion of a population that may be affected by a carcinogen during a lifetime of exposure (24 hours/day, 365 days/year, for life). For example, an estimated cancer risk of 2×10^{-6} represents potentially two excess cancer cases in a population of one million over a lifetime of continuous exposure.

7.1.1. Soil Exposure

ATSDR calculated exposure doses for both central tendency exposure (CTE), which refers to persons who have an average or typical soil intake rate, and reasonable maximum exposure (RME), which refers to persons who are at the upper end of the exposure distribution (approximately the 95th percentile). The RME scenario assesses exposures that are higher than average but still within a realistic exposure range. In the absence of complete exposure-specific information regarding soil exposures, ATSDR applied several conservative exposure assumptions to define site-specific CTE and RME (see Table 10B, Appendix B). Site-specific assessments for arsenic's RBA in soil are not available; therefore, the bioavailability of arsenic was assumed to be 60% [USEPA 2012a, 2012b].

In Table 6B, Appendix B, ATSDR provides estimated doses for the most highly exposed groups for various arsenic concentration ranges. ATSDR also provides in this table the number of 35th Avenue properties with arsenic concentrations within the specified ranges. Overall, this table indicates there are fewer properties in the current scenario with arsenic levels within the highest concentration ranges. In addition, Table 2B, Appendix B, indicates that although the mean arsenic level for properties targeted for removal actions is 52 ppm, following removal actions, the mean for the remaining properties is 22 ppm.

However, Table 6B, Appendix B, indicates there are about 20 properties in the past and 3 properties currently with surface soil levels of arsenic ≥ 90 ppm. For children who intentionally eat soil (which leads to a higher than normal soil intake), arsenic concentrations ≥ 90 ppm were and are at a level of public health concern for acute (short-term) exposures because the estimated doses approach the arsenic LOAEL of 0.05 mg/kg/day. The maximum levels of arsenic (1,000 ppm and 1,336 ppm) for two properties were and are of concern for children who do not intentionally eat soil because the estimated dose approaches the arsenic LOAEL. By definition, LOAEL doses cause harmful health effects. The likelihood of harmful health effects increases as site-specific doses approach a LOAEL, and are of particular concern when the LOAEL is classified as "serious"[9], such as is the case of the arsenic LOAEL. If children live at or visit the two properties and participate in contact-intense activities[10], it is plausible that they may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Children who eat dirt are especially at risk. ATSDR would not expect adults, including women and gardeners, to experience harmful health effects from short-term exposures to arsenic in surface soil.

ATSDR would not expect adults, including women and gardeners, to experience noncancer harmful health effects from long-term exposures to arsenic in surface soil. For chronic[11] child exposures (i.e., those lasting a year or longer), arsenic levels in surface soil ≥ 150 ppm are at and exceed the threshold dose for dermal effects of 0.002 mg/kg/day. Sample results show 10 properties in the past and 2 properties currently have arsenic in soil above levels that may lead to dermal effects. Note that it is more likely that children will come into frequent, repeated contact with the soil in residential yards that contain gardens or play areas with bare soil. Overall, ATSDR considers long-term exposure to elevated arsenic concentrations of potential public health concern for children for noncancerous health effects, especially at properties with gardens and play areas with bare soil.

With regard to cancer risk, ATSDR calculated cancer risk estimates using the formula shown in Exhibit 2 and the US EPA arsenic oral CSF of 1.5 $(mg/kg/day)^{-1}$. To determine cancer risk, ATSDR looked at two exposure populations: children exposed from birth to 21 years of age and adults exposed for 33 years. For children, exposure to surface soil with levels of arsenic ≥ 61 ppm may result in an estimated cancer risks at and exceeding 1×10^{-4} (one case in ten thousand persons), which ATSDR considers a level of concern for lifetime cancer risk [ATSDR 2004]. For adults, arsenic surface soil levels ≥ 120 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}.

The American Cancer Society estimates 1 in 3 Americans will get some form of cancer during their lifetime. That means for every 10,000 people, on average 3,333 will get some kind of cancer. Exposure to arsenic every day at about 66 properties in the past and 30 properties currently may make the lifetime risk of getting cancer higher by one case – from 3,333 to 3,334. The actual number of people getting cancer caused by exposure to arsenic in soil may be higher or lower, and could be none, because this is an estimate.

Note also that the harmful health effects observed in the studies on arsenic ingestion involved daily, long-term ingestion of elevated arsenic levels in drinking water. It is not likely that ingestion of large

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[9] ATSDR classifies LOAELs into "less serious" or "serious" effects. "Serious" effects are those that evoke failure in a biological system. "Less serious" effects are those that are not expected to cause significant dysfunction [ATSDR 2007a].

[10] Contact-intense activities include digging with shovels and other tools, and playing with toys (like toy trucks and action figures) on the ground surface. Children can be exposed by putting soiled hands or toys in their mouth or by breathing or eating dust generated by their activities.

[11] Note that some preschool children might intentionally eat soil once during their preschool years, while others might go through a stage of eating soil several times during a week or even over several months [ATSDR 2014]. Overall, though, intentionally eating soil is not considered to occur over the long-term, i.e., every day for longer than a year.

amounts of soil would occur 365 days a year for life. Therefore, ATSDR considers arsenic soil exposures at most properties to represent a low cancer risk.

7.1.2. Homegrown Garden Produce

As stated previously, garden plants grown in arsenic-contaminated soils can take up small amounts of arsenic in their roots and arsenic can be deposited as a particulate on the surface of the plant [Thorton 1994; Samsøe-Petersen et al. 2002; ATSDR 2007a]. For the 35th Avenue site, arsenic was detected in only 1 of 20 samples, an unwashed collard green sample, at a concentration of 0.069 mg/kg. For the highest exposed group (i.e., children 1 to > 2 years of age), the arsenic dose[12] for this garden produce sample would be 0.001 mg/kg/day, which is below arsenic's threshold dose for chronic effects of 0.002 mg/kg/day. Overall, because arsenic was not detected in the majority of garden produce samples and because the estimated dose is below the arsenic chronic threshold dose, ATSDR would not expect ingestion of arsenic in garden produce alone to be of health concern. However, the maximum garden produce level may be of health concern for people who are also exposed to elevated levels of arsenic in their garden soil. The combined exposure to arsenic in surface soil and garden produce may exceed the threshold dose for chronic effects.

People who are concerned about arsenic contamination may reduce their exposure to chemicals in their homegrown produce by peeling root crop vegetables, such as carrots and potatoes. Another way to minimize exposures is to remove dirt from garden produce before bringing it into the home. Washing homegrown produce thoroughly will also remove soil particles that may contain arsenic. See Appendix C for prudent public health measures people can take to reduce soil and garden produce exposures and to protect themselves, their families, and visitors.

7.2. Lead

Lead is a naturally occurring bluish-gray metal found in the earth's crust and it has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. Prior to 1955, there were no limits on lead in paint, but it is estimated that it was between 2.5% and 5%. After 1978, there is less than 0.06% lead in paint. Using lead as an additive to gasoline was banned in 1996 in the United States.

Today, lead can be found in all parts of the environment because of human activities including burning fossil fuels, mining, manufacturing, and past uses [ATSDR 2007b, 2007c]. Because of this, lead is often found in the body in low levels. In the past three decades, however, blood lead levels (BLLs) in the general public have decreased by 78% as a result of the regulation of lead in gasoline, paint, and plumbing materials [ACCLPP 2007].

Lead has no physiological value, and if it gets into the body, lead can affect various organ systems and be stored in the bones. Lead that is not stored in bones leaves the body as waste. About 99% of the amount of lead taken into the body of an adult will be excreted in the waste within a couple of weeks, while about 30% of the lead taken into the body of a child will leave in the waste [ATSDR 2007b]. Most of the remaining lead moves into bones and teeth. Lead can stay in bones for decades; however, some lead

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[12] For its calculation, ATSDR used the US EPA 95th percentile for consumer-only intake of fruits and vegetables for 1 to > 2 years of age, which is 21.4 g/kg-day, and US EPA's formula for residential ingestion of fruits and vegetables [USEPA 1989, 2011b].

can leave bones and reenter the blood and organs under certain circumstances; for example, during pregnancy, after a bone is broken, and during advancing age.

Lead can be found in many products and locations. Lead-based paint and contaminated dust are the most widespread and dangerous high-dose source of lead exposure for young children [CDC 2009]. However, lead exposure can occur from many indoor, outdoor, and other sources [CDC 2009; NYDOH 2010]. Table 11B, Appendix B, provides additional information about these sources.

Lead uptake, especially from the gastrointestinal tract, is influenced by nutrients such as calcium and iron as they occur in meals or with intermittent eating. Lead uptake generally increases as dietary levels of these nutrients decrease. Appendix D provides ways people can reduce lead uptake, such as eating healthy foods. In addition, lead uptake is a function of age, administered dose, the chemical species, and the particle size of the lead-containing media [USEPA 1994].

Lead-contaminated dust can be inhaled or ingested. Once airborne lead deposits onto soil, it does not dissipate, biodegrade, or decay easily. Lead usually binds to soil and indoor dust and can become a long-term source of lead exposure. Exposure to lead-contaminated soil can be affected by particle size, ground cover, soil conditions, seasonal variation, behavior patterns, a person's age, outdoor activity, and a variety of other risk factors. Many factors can influence uptake, such as lead bioavailability and individual nutritional status, and therefore the blood lead levels.

Exposure to lead can occur through garden produce grown in lead-contaminated soil. One study showed that all garden vegetable plants grown in contaminated soil accumulate lead to some level, and that the majority of the contamination is in the plant root. Smaller levels of lead were found in the plant shoot, with low to non-detectable levels in the edible fruit (e.g., tomatoes, peppers, beans, and zucchini) [Finster et al. 2004]. Most lead compounds are relatively insoluble; therefore, natural plant uptake is minimal [Barocsi et al. 2003].

In addition to contact with lead-contaminated environmental media, multiple factors have been associated with increased risk of higher BLLs. These factors include [Bernard and MecGeehin 2003; CDC 2005, 2013a, 2013b; Dixon et al. 2009; Holstege et al. 2013; Jones et al. 2009; Lee et al. 2005; Mielke et al. 2010; Shannon et al. 2005; US Census Bureau 2010b; USEPA 2013b]

- Children[13] less than 6 years of age
- Blacks and Hispanics
- People who live in homes built before 1978
- People who live in rental property
- Those in poverty
- New immigrant and refugee populations
- People born in Mexico
- Living in an urban area

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[13] Lead can also harm a developing fetus, so pregnant women or women likely to become pregnant should be especially careful to avoid exposure to lead [Mayo Clinic 2015].

- Living in specific regions of the U.S. (i.e., Northeast > Midwest > South> West)

Blood Lead Levels and Health Effects

Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects [ATSDR 2007b, 2007c].

In May 2012, the Centers for Disease Control and Prevention (CDC) updated its recommendations on children’s blood lead levels. By shifting the focus to primary prevention of lead exposure, CDC wants to reduce or eliminate dangerous lead sources in children’s environments before they are exposed.

- *Blood Lead Reference Level now 5 µg/dL* – Until recently, children were identified as having a blood lead level of concern if the test result was 10 or more micrograms per deciliter (µg/dL) of lead in blood. Experts now use a reference level of 5 µg/dL. This reference level is based on the highest 2.5% of the U.S. population of children 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) [ACCLPP 2012; CDC 2012a, 2012b]. The current (2011–2012) geometric mean BLL for that age group is 0.97 µg/dL [CDC 2015].
- *No Change in Blood Lead Levels Requiring Medical Treatment* – What has not changed is the recommendation for when to use medical treatment for children. Experts recommend chelation therapy when a child is found with a test result equal to and greater than 45 µg/dL [CDC 2014], however chelation is not without risks.
- *Health Effects in Children with Measurable Blood Lead Levels less than 5 µg/dL and 10 µg/dL* – There is no clear threshold for some of the more sensitive health effects associated with lead exposures. In children, the National Toxicology Program reports conclusions on health effect studies of low-level lead exposure for both <5 µg/dL and <10 µg/dL where there is sufficient evidence of [NTP 2012]
    - Decreased academic achievement (<5 µg/dL),
    - Decreased intelligence quotient (IQ) (<5 µg/dL and <10 µg/dL),
    - Decreased specific cognitive measures (<5 µg/dL),
    - Increased incidence of attention-related and problem behavior (<5 µg/dL),
    - Decreased hearing (<10 µg/dL),
    - Reduced postnatal growth (<10 µg/dL), and
    - Delays in puberty (<10 µg/dL).
- *Health Effects of Lead on Developing Fetuses* – Lead crosses the placenta; consequently, it can pass from a pregnant woman to her developing fetus. Follow-up testing, increased patient education, and environmental, nutritional and behavioral interventions are indicated for all pregnant women with BLLs greater than or equal to 5 µg/dL to prevent undue exposure to the developing fetus and newborn [CDC 2013c]. Too much lead in a pregnant women’s body can [CDC 2013C]
    - Put her at risk for miscarriage,
    - Cause the baby to be born too early or too small,

  - Hurt the baby's brain, kidneys, and nervous system, and
  - Cause the child to have learning or behavior problems.
- *Health Effects for Adults* – Adults who are exposed to lead over many years could develop kidney problems, high blood pressure, cardiovascular disease, and cognitive dysfunction [Kosnett et al. 2007].

Neither ATSDR nor US EPA has developed a MRL or RfD for exposure to lead. Therefore, ATSDR cannot use the usual approach of estimating human exposure to an environmental contaminant and then comparing that dose to a health based comparison value (such as an MRL of RfD). Instead, lead is evaluated using a biological model that predicts blood lead concentrations that could result from human exposure to environmental lead contamination. Specifically for this PHC, ATSDR evaluated exposure to lead by using US EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children.

Note also that the US EPA developed the Adult Lead Methodology (ALM) to predict the risk of elevated blood lead levels in nonresidential settings, such as the workplace, for adult women's exposures to soil; however, the ultimate receptor is the fetus. More information about US EPA's adult lead methodology can be found at http://www.epa.gov/superfund/lead/products.htm.

IEUBK Model

The IEUBK model calculates exposure from lead in air, water, soil, dust, diet, paint, and other sources and predicts the risk of elevated blood lead levels in children 6 months to 7 years of age. The model can also be used to predict risk for specific age groups up to age 7. There is currently no generally accepted model for predicting blood lead concentrations for children 7 years of age and older.

The IEUBK model is designed to integrate exposure with pharmacokinetic modeling to predict blood lead concentrations. The four main components of the current IEUBK model are: 1) an exposure model that relates environmental lead concentrations to age-dependent intake of lead into the gastrointestinal tract; 2) an absorption model that relates lead intake into the gastrointestinal tract and lead uptake into the blood; 3) a biokinetic model that relates lead uptake in the blood to the concentrations of lead in several organ and tissue compartments; and 4) a model for uncertainty in exposure and for population variability in absorption and biokinetics [USEPA 1994].

The IEUBK model results can be viewed as a predictive tool for estimating changes in blood concentrations as exposures are modified [USEPA 1994]. The IEUBK model provides choices a user may make in estimating a child's blood lead concentration. These are referred to "user-specified" parameters or decisions. The reliability of the results obtained using the model is very dependent on the selection of the various coefficients and default values that were used. Section 7.4 discusses some of the limitations of the model.

7.2.1. Soil

ATSDR ran the IEUBK model (IEUBKwin Model 1.1 Build 11) using default parameters for all inputs except 1) the soil level, which was set to various lead levels for each model run, and 2) the BLL reference level for risk estimation, which was set to 5 µg/dL.

In Table 7B, Appendix B, ATSDR provides the IEUBK estimated probability of exceeding a BLL of 5 µg/dL and the geometric mean BLLs for various lead concentration ranges. ATSDR also provides in this table the number of 35th Avenue grids and properties with lead concentrations within the specified ranges.

Table 7B, Appendix B, shows there are properties with high levels of lead in soil, indicating the potential for elevating BLLs in children who live at or visit these properties. Children who intentionally eat dirt are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Other indoor and outdoor sources (see Table 11B, Appendix B) may result in elevating BLLs even further. Also, multiple factors that have been associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race)[14]. Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.

Overall though, US EPA reduced exposure to lead-contaminated soil through its TCRA. Table 7B, Appendix B, indicates there are fewer properties in the current scenario with lead levels within the highest concentration ranges. In addition, Table 3B, Appendix B, indicates the maximum level of lead in soil decreased from 27,000 ppm (areas identified for removal actions) to 1,900 ppm (current exposure scenario for properties remaining after removal actions). This table also shows that although the mean lead level for properties targeted for removal actions is 1,110 ppm, following removal actions, the mean lead level for the remaining properties is 178 ppm.

However, lead cannot be entirely eliminated from the environment so there will always be some residual levels following cleanup actions at lead-contaminated sites and children may be exposed to non-site-specific sources of lead (e.g., lead-based paint in homes built before 1978). Eliminating exposure pathways by controlling contamination sources and practicing good personal hygiene can help prevent high levels of lead in blood (see Appendices D and E).

Blood Lead Data Review

ATSDR reviewed available BLL data from two sources: the Jefferson County Department of Health (JCDH) and the Alabama Department of Public Health (ADPH).

1. On July 18 and July 23, 2013, JCDH conducted BLL screening events specifically for the 35th Avenue community. Of the 44 participants (1–70 years of age), JCDH found that no BLLs exceeded 5 µg/dL. Overall though, 15 of the 44 participants (34%) did not actually live within the boundaries of the site [JCDH 2013]. About 30% (13 participants) were children 1–5 years of age, but two of these children did not live within the site area. For all 13 children 1–5 years of age who participated, the geometric mean BLL was 1.4 µg/dL, with a 95% confidence interval (CI) on the geometric mean of 1.1–1.9 µg/dL (see Table 12B, Appendix B). For the 11 children 1–5 years of age who live within the site boundary, the geometric mean BLL was 1.3 µg/dL, with a 95% CI on the geometric mean of 1.0–1.7 µg/dL.

2. ADPH conducts the Alabama Childhood Lead Poisoning Prevention Project (ACLPPP). ACLPPP has the following mission [ADPH 2015]:

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[14] For the population within the site boundaries, 98% are black [US Census Bureau 2010a]. The site straddles two census tracts, and 95% of the housing was built before 1978 in tract 01073005500 and 98% in tract 01073000700 [US Census Bureau 2013]. About 24% of the population was below the poverty line in tract 01073005500 and 41% in tract 01073000700 [US Census Bureau 2010b].

> Our mission is to help every child in Alabama develop to his or her maximum potential by promoting a lead free environment and healthy lifestyle. To accomplish this mission ACLPPP provides public outreach and education, case investigation, and case management[15] services to help prevent further lead exposure in Alabama's children.

Per a request from ATSDR, ADPH provided 2010–2014 BLL data for children in the ZIP code 35207 [ATSDR 2015]. The 35th Avenue site lies within this ZIP code (see Figure 1A, Appendix A). A total of 560 BLL results were available for children ≤ 21 years of age. For children 1–5 years of age, 16 of 329 BLL tests (4.9%) were ≥ 5 µg/dL (see Table 13B, Appendix B). The maximum BLL was 16 µg/dL and the geometric mean was 1.7 µg/dL (95% CI of 1.6–1.9 µg/dL). For children 6–11 years of age, 9 of 214 BLL tests (4.2%) were ≥ 5 µg/dL. The maximum BLL was 10 µg/dL and the geometric mean was 1.9 µg/dL (95% CI of 1.7–2.0 µg/dL). However, the ZIP-code level BLL data may not necessarily be representative of the site area because 1) the ACLPPP endeavors to test children with the highest risk for elevated blood lead levels, and 2) the ZIP code data encompassed a larger area than just the site.

US EPA is currently determining its options toward future phases of removal action. Because ATSDR recognizes that even low levels of lead in blood have been shown to have harmful effects, the agency supports additional efforts by US EPA to reduce lead levels in soil at the 35th Avenue site. The agency also understands parents with young children may still be concerned about lead exposures. ATSDR recommends parents consider following the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012]. ATSDR also recommends concerned residents take prudent public health measures to reduce their exposure (see Appendices C, D, and E). Further, ATSDR supports any future health education efforts undertaken by the JCDH. ATSDR can address questions about exposure to lead (toll-free 1-800-CDC-INFO.) When contacting ATSDR, please state you are requesting information related to the 35th Avenue site.

7.2.2. Homegrown Garden Produce

As stated previously, garden produce grown in contaminated soil can accumulate lead to some level. At the 35th Avenue site, lead was detected in 4 of 20 samples, with the maximum level of 0.57 mg/kg in a washed green onion sample.

ATSDR ran the IEUBK model (IEUBKwin Model 1.1 Build 11) using default parameters for all inputs except 1) the soil level, which was set to 100 ppm[16], 2) the diet values, which were set to 100% vegetables with 0.57 mg/kg lead, and 3) the BLL reference level for risk estimation, which was set to 5 µg/dL. The IEUBK output shows the probability of exceeding a BLL of 5 µg/dL as 4.7%. However, with increasing soil lead concentrations, the IEUBK outputs show increasing probabilities of exceeding a BLL of public health concern. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

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[15] Case management is defined as identifying an individual's needs and problems and devising a method to meet those appropriately and cost-effectively. Consultation with other health professionals and agencies helps the person take advantage of appropriate treatments and procedures. The goal is to assure proper follow-up for children with elevated blood lead levels [ADPH 2004].

[16] US EPA recommends < 100 ppm lead in soil for gardens [USEPA 2014b].

7.3. Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are produced by the incomplete combustion of organic materials such as coal, oil, wood, tobacco, and even food products [ATSDR 1995]. They are also found in petroleum products such as asphalt, coal tar, creosote, and roofing tar. As a result, they are very common in the environment from such processes as volcanic eruptions, forest fires, home wood burning, and vehicle exhaust. More than 100 PAHs are known to exist, and they are usually found in the environment as mixtures. The most studied PAH is benzo(a)pyrene (BaP).

Current ATSDR guidance indicates six of the seven PAHs detected in 35th Avenue soil should be evaluated as a mixture using a calculated benzo(a)pyrene toxic equivalent (BaP TE) value. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. As stated in Section 6, the BaP TE value is the sum of the different PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP.

PAHs tend to bind to soil particles. In soil, microbial metabolism is the major process for the degradation of PAHs. The rate and extent of biodegradation of PAHs in soil are affected by environmental factors such as the organic content, the structure and particle size of the soil, and the characteristics of the microbial population. BaP background concentrations for agricultural soil range from 0.0046–0.9 ppm, and 0.165–0.22 ppm for urban soil [ATSDR 1995].

Studies indicate elevated concentrations of PAHs can exist in soil at contaminated sites. Soil samples collected from the Fountain Avenue Landfill in New York City contained PAH concentrations ranging from 0.4–10 ppm [Black et al. 1989]. In a 1988 study at a hazardous waste land treatment site for refinery process wastes, average PAH concentrations in surface soils ranged from not detected for several PAHs to 340 ppm for dibenz(ah)anthracene [Loehr et al. 1993].

In general, plants may take up chemical contaminants either by absorbing them through their root system or through their leaves and stems. Chemicals in air may also settle on the above ground parts of plants [Simonich and Hites 1995]. Based on a review of the available scientific literature, chemicals such as PAHs are not thought to be taken into most plants by the root system [Wild et al. 1992; Simonich and Hites 1995; Samsøe-Petersen et al. 2002]. Studies also suggest that these chemicals may get into crops such as carrots and potatoes, but are located primarily in the peel [Wild et al. 1992; Samsøe-Petersen et al. 2002].

Swallowing soil or dust particles and eating garden produce that contain PAHs are routes for these chemicals to enter a person's body, but absorption is generally slow when PAHs are swallowed. PAHs also could enter through skin that comes into contact with soil containing high levels of PAHs. PAHs tend to be stored mostly in the kidneys, liver, and fat. Most PAHs that enter the body leave within a few days, primarily in the feces and urine [ATSDR 1995].

ATSDR has not derived oral MRLs for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for noncancer health effects. The animal oral data are limited because of conflicting results across studies, the use of inconsistent protocols (e.g., varying numbers of animals, administration of the test compound during different times of gestation), the use of only one dose, lack of study details, and most data are available only for BaP.

Although serious reproductive and developmental effects in animals associated with acute oral exposure to PAHs have been reported, these are not appropriate end points for the derivation of an acute MRL. The lowest BaP acute exposure levels reported in ATSDR's Toxicological Profile for Polycyclic Aromatic

Hydrocarbons [ATSDR 1995] are for developmental effects in mice at 10 mg/kg/day (NOAEL) and 40 mg/kg/day (LOAEL); and for reproductive effects in mice at 40 mg/kg/day (NOAEL) [Makenzie and Angevine 1981]. Noncancer effects noted in longer term oral toxicity studies in animals include increased liver weight and aplastic anemia (a serious effect), neither of which is an appropriate end point for the derivation of an MRL [ATSDR 1995]. These longer-term effects were seen in mice at levels starting at 120 mg/kg/day (LOAEL) [Robinson et al. 1975].

Tumors were observed in laboratory animals when they breathed, ate, or had long periods of skin exposure to PAHs. Human data specifically linking BaP to a carcinogenic effect are lacking. There are, however, multiple animal studies demonstrating BaP to be carcinogenic following administration by numerous routes [USEPA 1992].

Creosote contains PAHs. Workers who had long-term skin contact with creosote, especially during wood treatment or manufacturing processes, reported increases in skin cancer and cancer of the scrotum. Cancer of the scrotum has been associated with long-term exposure to soot and coal tar creosotes of chimney sweeps. Animal studies have also shown an association between creosote exposure and skin cancer [ATSDR 2002].

The CSF for BaP of 7.3 $(mg/kg/day)^{-1}$ is based on the geometric mean of four different dose response models using multiple species and both sexes. There were several types of cancer observed: forestomach, squamous cell papillomas and carcinomas; forestomach, larynx and esophagus, papillomas and carcinomas (combined). The US EPA considers the available human cancer data to be inadequate but the animal carcinogenic data on which the CSF is based to be sufficient [UPEPA 1992]. For dibenz(ah)anthracene, a potency of 4.1 $(mg/kg/day)^{-1}$ was derived using the linearized multistage model with the only dose-response data set available—a drinking water study (Snell and Stewart 1962) which reported alveolar carcinomas of the lung in male mice [Cal EPA 2005].

7.3.1. Soil

Similar to arsenic, ATSDR calculated exposure doses for CTE and RME for BaP TE and dibenz(ah)anthracene concentration ranges. ATSDR applied several conservative exposure assumptions to define site-specific CTE and RME (see Table 10B, Appendix B). PAH bioavailability was assumed to be 100%.

In Tables 8B and 9B, Appendix B, ATSDR provides estimated doses for various BaP TE and dibenz(ah)anthracene concentration ranges. ATSDR also provides in these tables the number of 35th Avenue properties with BaP TE and dibenz(ah)anthracene concentrations within the specified ranges. These tables indicates there are fewer properties in the current scenario with PAH levels within the highest concentration ranges. In addition, Table 4B, Appendix B, indicates that although the mean BaP TE level for properties targeted for removal actions is 6.8 ppm, following removal actions, the mean level for the remaining properties is 0.44 ppm. Table 5B, Appendix B, indicates that although the mean dibenz(ah)anthracene level for properties targeted for removal actions is 0.97 ppm, following removal actions, the mean level for the remaining properties is 0.10 ppm.

ATSDR has not derived oral MRLs for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for appropriate noncancer health effects. However, the doses at which noncancer health effects occurred in mice were many orders of magnitude higher than the PAH doses from soil exposures at this site. Therefore, it is unlikely that any noncancerous harmful health effects from PAH soil exposure would occur in children or adults.

With regard to cancer risk, ATSDR calculated cancer risk estimates using the US EPA oral CSF of 7.3 $(mg/kg/day)^{-1}$ for BaP and 4.1 $(mg/kg/day)^{-1}$ for dibenz(ah)anthracene. To calculate cancer risk, ATSDR followed US EPA's proposed risk calculations for chemicals that act with a mutagenic mode of action[17] for carcinogenesis [USEPA 2005]. For children, BaP TE surface soil levels ≥ 1.8 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}, which ATSDR considers a level of concern for lifetime cancer risk [ATSDR 2004]. For adults, BaP TE surface soil levels ≥ 25 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. For children, dibenz(ah)anthracene surface soil levels ≥ 3.5 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. For adults, dibenz(ah)anthracene surface soil levels ≥ 45 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}.

As stated in the arsenic section, the American Cancer Society estimated 1 in 3 Americans will get some form of cancer during their lifetime. That means for every 10,000 people, on average 3,333 will get some kind of cancer. ATSDR estimates the lifetime cancer risk of exposure to PAHs in soil at 125 properties in the past and 64 properties currently may make that number higher by one case – from 3,333 to 3,334. The actual number of people getting cancer caused by exposure to PAHs in soil may be higher or lower, and could be none, because this is an estimate.

Of note though, it is not likely that ingestion of large amounts of soil would occur 365 days a year for life. Therefore, ATSDR considers PAH soil exposures at most properties to represent a low cancer risk.

7.3.2. Homegrown Garden Produce

As stated previously, studies indicate that most plants do not take up significant amounts of PAHs from soil. Because PAHs were not detected in any of the 20 vegetable samples at the 35th Avenue site, PAHs in homegrown garden produce at this site are not at levels of health concern.

7.4. Limitations

ATSDR's public health evaluation has several limitations, some of which are noted here.

- Estimating an exposure dose required identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in the water and soil. ATSDR made several assumptions for site-specific exposure scenarios (see Table 10B, Appendix B). Although ATSDR's assumptions were conservative, each person's exposure might be higher or lower depending on his or her lifestyle and individual characteristics that influence contact with contaminated media.
- Although sample location, collection, and quality assurance procedures were established and resulted in a consistent, well-documented data set, ATSDR notes that not all property owners allowed access for sampling activities. About 1,100 of the approximately 2,000 parcels (about 55%) in the 35th Avenue site study area were tested. The untested properties may have elevated levels of soil contamination. The agency also notes that some property owners allowed access for sampling activities, but then denied access for removal activities.
- ATSDR's evaluation required the examination and interpretation of reliable, substance-specific, health effects data. The evaluation included a review of epidemiologic (human) and

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[17] Because BaP and dibenz(ah)anthracene are without chemical-specific data on early life exposures, age-dependent adjustment factors were applied [USEPA 2005].

experimental (animal) studies. A study based on human data would hold the greatest weight in describing relationships between a particular exposure and a human health effect. However, in some cases, only animal studies were available.

- Substance-specific health effects data are generally expressed in terms of “ingested dose” rather than “absorbed dose.” With regard to heavy metal exposure in soil, however, the distinction between ingested dose and absorbed dose is important. In general, ingestion of a metal in contaminated soil may be absorbed into the body to a much lesser extent than when the metal is in drinking water or food.
- The IEUBK model depends on reliable estimates of site-specific information for several key parameters that include the following:
    - Lead concentration in outdoor soil (fine fraction) and indoor dust,
    - Soil/dust ingestion rate,
    - Lead concentration in deteriorating paint and indoor paint dust,
    - Individual variability in child blood lead concentrations affecting the Geometric Standard Deviation (GSD) and,
    - Rate and extent of lead absorption from soil (i.e., bioavailability).

  If reliable site-specific inputs are not available, the model will use default parameters which are considered conservative. For its soil evaluation, ATSDR used default parameters for all inputs except 1) the soil level was set to various lead levels for each model run, and 2) the BLL reference level for risk estimation was set to 5 µg/dL.
- A limitation of the IEUBK model is that the model was designed to evaluate relatively stable exposure situations, rather than rapidly varying exposures or exposures occurring for less than a year. The IEUBK model was also not developed to assess lead risks for age groups older than 7 years. The model does not take into account the soil cover (e.g., vegetation) and whether there is limited contact with the bare soil. The model assumes that children do not have any nutritional challenges or intentionally eat soil.
- The available site-specific and ZIP code level BLL data may not necessarily be representative of the site area. For the site-specific BLL events, 34% of the overall BLL participants did not actually live within the boundaries of the site. The ZIP code data encompassed a larger area than just the site.

Overall, there are recognized uncertainties in ATSDR’s evaluation. But providing a framework that puts site-specific exposures and the potential for harm into perspective is one of the primary goals of this health evaluation process [ATSDR 2005].

8. Conclusions

For the 35th Avenue site, US EPA provided ATSDR with arsenic, lead, and PAH sampling results for surface soil samples collected from November 2012 through February 2015 and garden produce samples collected in July 2013. Following its review of the residential surface soil and homegrown garden produce data, ATSDR reached three health-based conclusions.

1. ATSDR concludes that past and current exposure to arsenic found in surface soil of some residential yards could harm people's health. Children are especially at risk.

   - About 20 of over 1,100 tested properties in the past and 3 properties currently have soil arsenic levels of public health concern for children who intentionally eat soil (which leads to a higher than normal soil intake) for acute (short-term) exposures. These children may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Also, the maximum levels of arsenic at two properties in the past and one property currently were and are of concern for short-term exposures for all children, even those who do not intentionally eat soil. Children who frequently engage in activities like digging with shovels and other tools, and playing with toys (such as toy trucks and action figures) on the ground surface at these properties are especially at risk.
   - For chronic (long-term) exposures, about 10 of over 1,100 tested properties in the past and 2 properties currently have soil arsenic levels of potential public health for children for noncancerous dermal health effects (e.g., hyperpigmentation and hyperkeratosis). Children who engage in activities like digging with shovels and playing with toys on the ground surface every day for longer than a year are at risk, especially at properties with gardens and play areas with bare soil.
   - About 66 of over 1,100 tested properties in the past and 30 properties currently have soil arsenic levels that increase the risk of cancer by 1 in 10,000 people, which ATSDR considers a level of concern for lifetime cancer risk. Overall, ATSDR considers arsenic soil exposures at most properties to represent a low cancer risk.
   - Although ingestion of arsenic in homegrown garden produce alone is not of health concern, exposure to the maximum arsenic level found in the garden produce may add to the health risk for those also exposed to elevated levels of arsenic in surface soil.

2. ATSDR concludes that past and current exposure to lead found in surface soil of some residential yards could harm people's health. Swallowing lead-contaminated soil, along with lead from other sources such as lead paint, could cause harmful health effects, especially in children and in the developing fetus of pregnant women.

   - Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects. ATSDR notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
   - There are some residential properties with high levels of lead in surface soil, indicating the potential for elevating blood lead levels (BLLs) in children who live at or visit these properties.

Children who intentionally eat soil are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Other indoor and outdoor sources of lead may result in elevating BLLs even further. Also, multiple factors that have been associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race). Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.

- ATSDR reviewed available BLL data from two sources.
    - In July 2013, the Jefferson County Department of Health conducted a limited site-specific BLL screening event of 44 participants (1–70 years of age). Thirteen participants were children 1–5 years of age, although two of these children did not live within the site boundaries. No BLLs exceeded the current 5 micrograms per deciliter (µg/dL) reference level[18] for children 1–5 years of age. Overall, 15 of the 44 participants (34%) did not actually live within the boundaries of the site.
    - The site lies in ZIP code 35207. The Alabama Department of Public Health provided ATSDR with 2010–2014 BLL data for 560 children ≤ 21 years of age living within this ZIP code. This ZIP-code review indicated 25 children 1–5 and 6–11 years of age had BLLs at and above 5 µg/dL. However, the ZIP-code level BLL data may not necessarily be representative of the site area.
- Although ingestion of lead in garden produce is not of health concern, it will increase the risk of harm with increasing soil lead concentrations. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

3. ATSDR concludes that long-term exposure (i.e., many years) to PAHs found in the surface soil of some residential yards is at a level of concern for lifetime cancer risk.

- Several PAHs have been linked with tumors in laboratory animals when they breathed, ate, or had long periods of skin exposure to these substances. Benzo(a)pyrene (BaP) has been linked with stomach cancer and dibenz(ah)anthracene with lung cancer.
- Seven PAHs were detected in residential surface soil. For six of these PAHs, ATSDR calculated a benzo(a)pyrene toxic equivalent (BaP TE) value for each sample. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. The BaP TE value is the sum of these six PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP. About 125 of over 1,100 tested properties in the past and 64 properties currently have soil BaP TE levels that increase the risk of cancer by 1 in 10,000 people, which ATSDR considers a level of concern for lifetime cancer risk.

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[18] This reference level is based on the highest 2.5% of the U.S. population of children ages 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES). NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. As part of the examination component, blood, urine, and other samples are collected and analyzed for various chemicals. The NHANES test population is selected to be representative of the civilian, noninstitutionalized population of the United States.

- For dibenz(ah)anthracene, 14 of over 1,100 tested properties in the past and 2 properties currently have soil levels that increase the risk of cancer by 1 in 10,000 people.
- Overall, ATSDR considers long-term PAH soil exposures at most residential properties to represent a low cancer risk.

9. Recommendations

After its review of available information, ATSDR recommends

1. Parents monitor their children's behavior while playing outdoors and prevent their children from intentionally or inadvertently eating soil.
2. Residents take measures to reduce exposures to residential soil and to protect themselves, their families, and visitors (see Appendix C).
3. Parents follow the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012].
4. Residents take steps to reduce lead uptake (see Appendix D).
5. Residents take measures to reduce exposure to lead from other possible sources (see Table 11B, Appendix B, and Appendix E).
6. US EPA test the bioavailability of metals (arsenic and lead) in the soil.
7. US EPA continue with its plans to remediate additional properties to reduce arsenic, lead, and PAH levels in residential surface soil.

10. Public Health Action Plan

The purpose of the public health action plan is to ensure that this evaluation not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment.

ATSDR provided its recommendations to US EPA and JCHD. ATSDR supports continued health education efforts by these entities to address the health concerns of the community and continued efforts to identify and reduce exposure to chemicals in the soil wherever possible.

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Appendix A. Figures

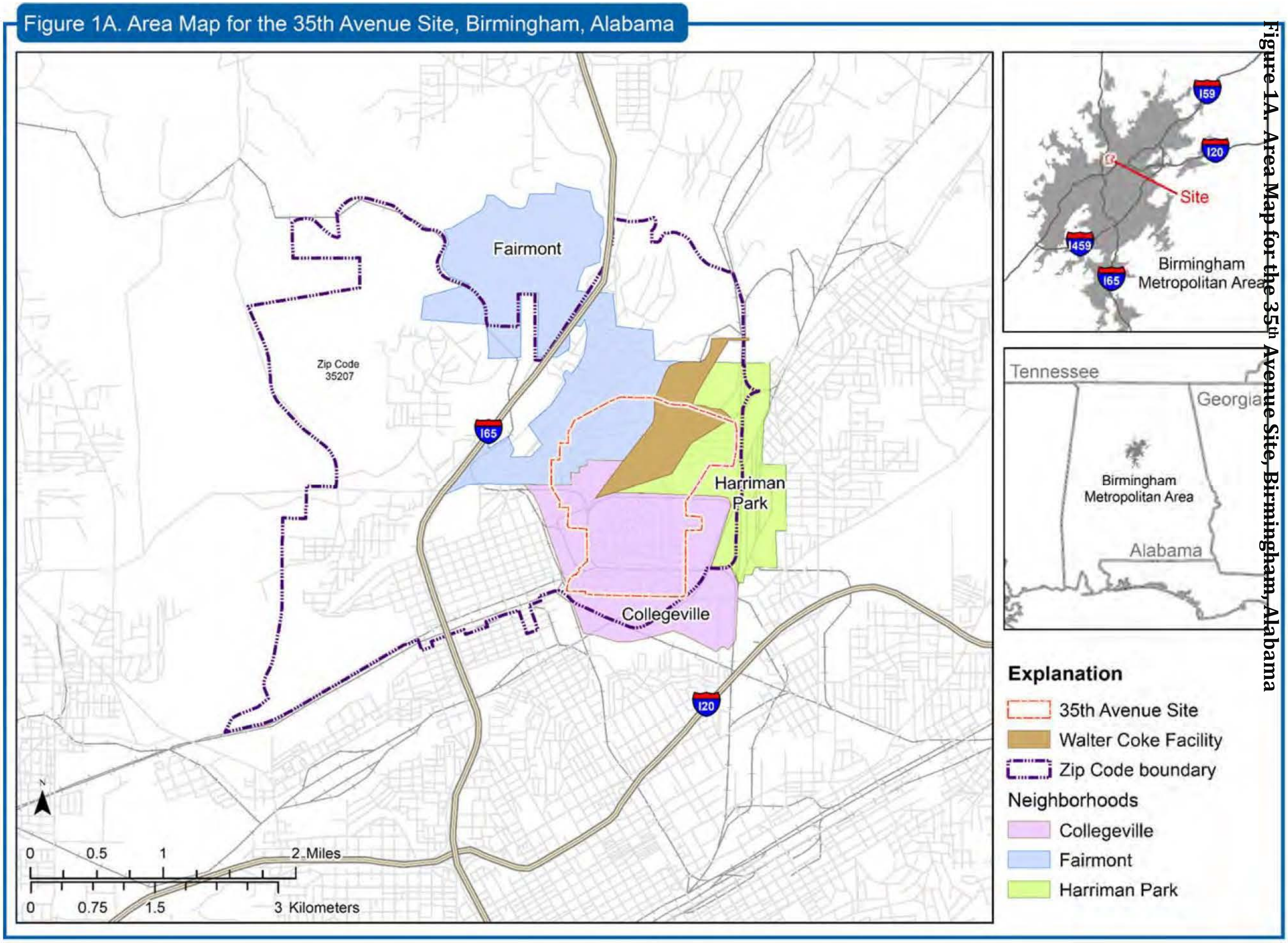
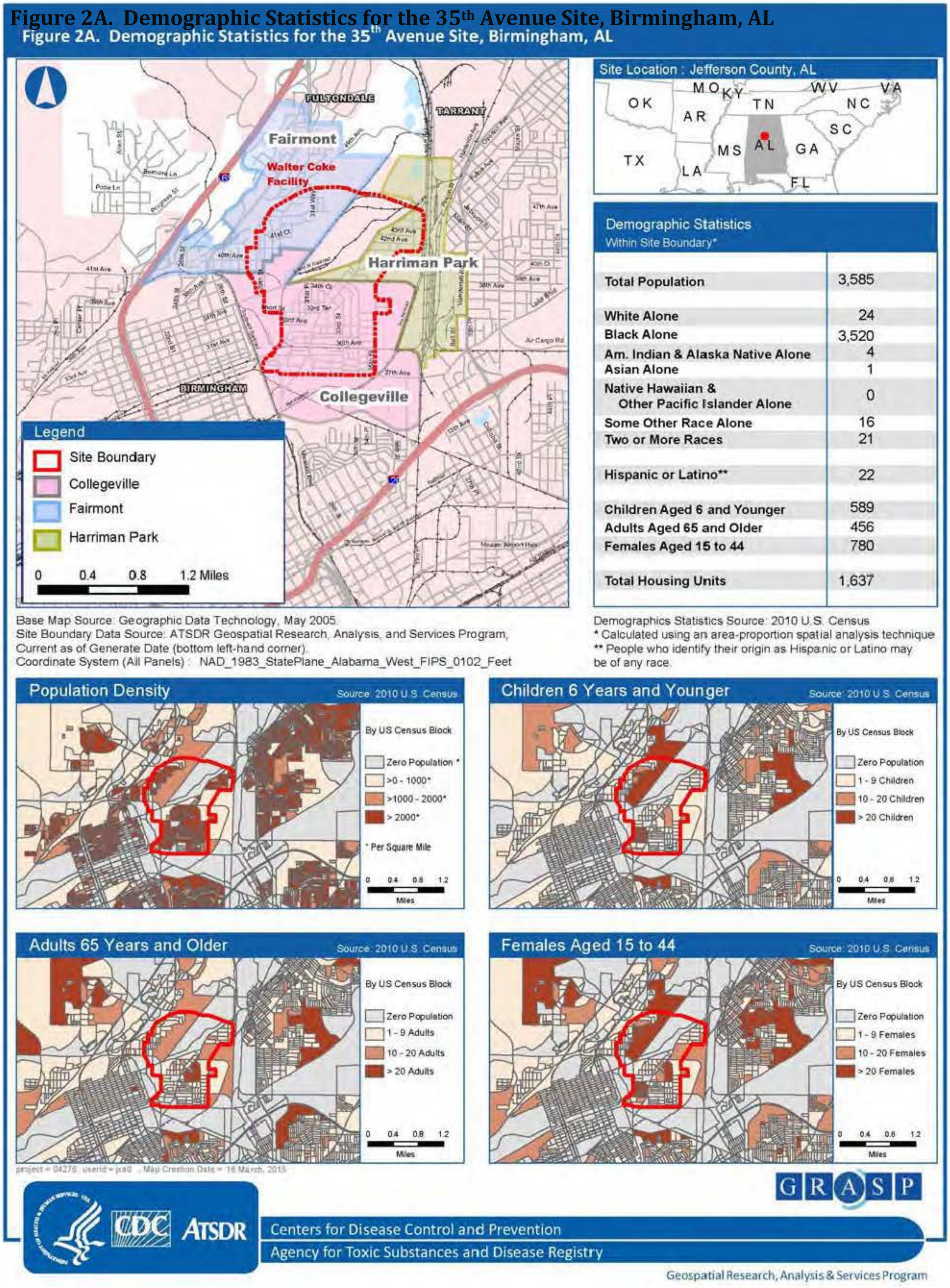


Figure 1A. Area Map for the 35th Avenue Site, Birmingham, Alabama

Figure 2A. Demographic Statistics for the 35th Avenue Site, Birmingham, AL



Demographic Statistics
Within Site Boundary*

Total Population	3,585
White Alone	24
Black Alone	3,520
Am. Indian & Alaska Native Alone	4
Asian Alone	1
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	16
Two or More Races	21
Hispanic or Latino**	22
Children Aged 6 and Younger	589
Adults Aged 65 and Older	456
Females Aged 15 to 44	780
Total Housing Units	1,637

Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD_1983_StatePlane_Alabama_West_FIPS_0102_Feet

Demographics Statistics Source: 2010 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

Appendix B. Tables

Table 1B. Definition of Statistical Terms*

Term	Definition
Minimum	The minimum is the lowest value in the data set.
Maximum	The maximum is the highest value in the data set.
Mean	The mean, also called the average, is a measure of the center of the data. The mean is obtained by adding all of the data values together and dividing the total by the number of data values.
Median	The median, also known as the 50th percentile, is another measure of the center of the data. If the data are ordered from highest to lowest, the median is the value that is in the middle of the data. For any given data set, 50% of the data will be above the median and 50% of the data will be below the median. Because the median is less affected by extreme values in the data, it can be a better–or more robust–central measure than the average.
25th percentile	The 25th percentile is the value that delineates the lowest 25% of the data values from the upper 75% of the data values.
75th percentile	The 75th percentile is the value that delineates the highest 25% of the data values from the lowest 75% of the data values.
Interquartile range	The interquartile range (IQR) is the range between the first and third quartiles (Q3-Q1), which corresponds to the data within the 25th and 75th percentiles. The range represents 50% of the data.
Confidence interval	A confidence interval is a range of values that will likely contain the value of the parameter of interest–the mean for example. A confidence interval typically has a percentage level associated with it that indicates how often the interval will contain the true value of the parameter of interest. Common levels for the confidence interval are 90%, 95%, and 99%.

* Reference Tables 2B–5B for application of these terms to the site-related soil data.

Table 2B. Descriptive Statistics for Arsenic in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of grids		2,912	222	2,690
Number of properties		1,119	122	997
Concentration (ppm)	Maximum	1,336	1,336	1,000
	75th percentile	28	53	27
	Median	19	33	19
	25th percentile	13	21	13
	Minimum	3.1	6.8	3.1
	Interquartile range	15	32	14
	Mean§	24	52	22
	95% confidence interval on the mean§	23 – 26	41 – 67	21 – 23
Number of grids > 15 ppm (ATSDR chronic child EMEG)		1,971	195	1,776
Number of properties > 15 ppm (ATSDR chronic child EMEG)		944	114	830

Data Source: USEPA 2015b.

* The “Past Exposure Scenario” column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The “Removal Action Areas” column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

‡ The “Current Exposure Scenario” column provides descriptive statistics for chemical levels found in surface soil following removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site following the TCRA).

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ATSDR	Agency for Toxic Substances and Disease Registry
EMEG	environmental media evaluation guide
ppm	part per million
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 3B. Descriptive Statistics for Lead in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas[†]	Current Exposure Scenario[‡]
Number of grids		3,028	224	2,804
Number of properties		1,122	122	1,000
Concentration (ppm)	Maximum	27,000	27,000	1,900
	75th percentile	234	774	213
	Median	133	396	128
	25th percentile	81	154	79
	Minimum	2	40	2
	Interquartile range	153	620	134
	Mean[§]	247	1,110	178
	95% confidence interval on the mean[§]	218 – 281	756 – 1,541	172 – 184

Data Source: USEPA 2015b.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

[†] The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

[‡] The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil following removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site following the TCRA).

[§] Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ppm	part per million
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 4B. Descriptive Statistics for BaP TE in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of grids		3,023	223	2,800
Number of properties		1,122	122	1,000
Concentration (ppm)	Maximum	322	322	58
	75th percentile	0.50	4.0	0.44
	Median	0.24	1.4	0.22
	25th percentile	0.11	0.36	0.11
	Minimum	0.005	0.04	0.005
	Interquartile range	0.39	3.6	0.33
	Mean§	0.91	6.8	0.44
	95% confidence interval on the mean§	0.69 – 1.2	4.1 – 11	0.39 – 0.50
Number (%) of grids > 0.096 ppm (ATSDR BaP CREG)		2,424	214	2,210
Number (%) of properties > 0.096 ppm (ATSDR BaP CREG)		1,025	119	906

Data Source: USEPA 2015b.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

‡ The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil following removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site following the TCRA).

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ATSDR	Agency for Toxic Substances and Disease Registry
BaP	benzo(a)pyrene
BaP TE	benzo(a)pyrene toxic equivalent
CREG	cancer risk evaluation guide
ppm	part per million
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 5B. Descriptive Statistics for Dibenz(ah)anthracene in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas[†]	Current Exposure Scenario[‡]
Number of grids		3,022	223	2,799
Number of properties		1,122	122	1,000
Concentration (ppm)	Maximum	41	31	41
	75th percentile	0.10	0.64	0.09
	Median	0.05	0.23	0.05
	25th percentile	0.03	0.09	0.03
	Minimum	0.003	0.004	0.003
	Interquartile range	0.07	0.55	0.06
	Mean[§]	0.16	0.97	0.10
	95% confidence interval on the mean[§]	0.13 – 0.21	0.63 – 1.4	0.08 – 0.14

Data Source: USEPA 2015b.

[*] The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

[†] The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

[‡] The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil following removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site following the TCRA).

[§] Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ppm	part per million
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 6B. Estimated Doses, Number of Grids, and Number of Properties within Various Arsenic Concentration Ranges, Birmingham, AL

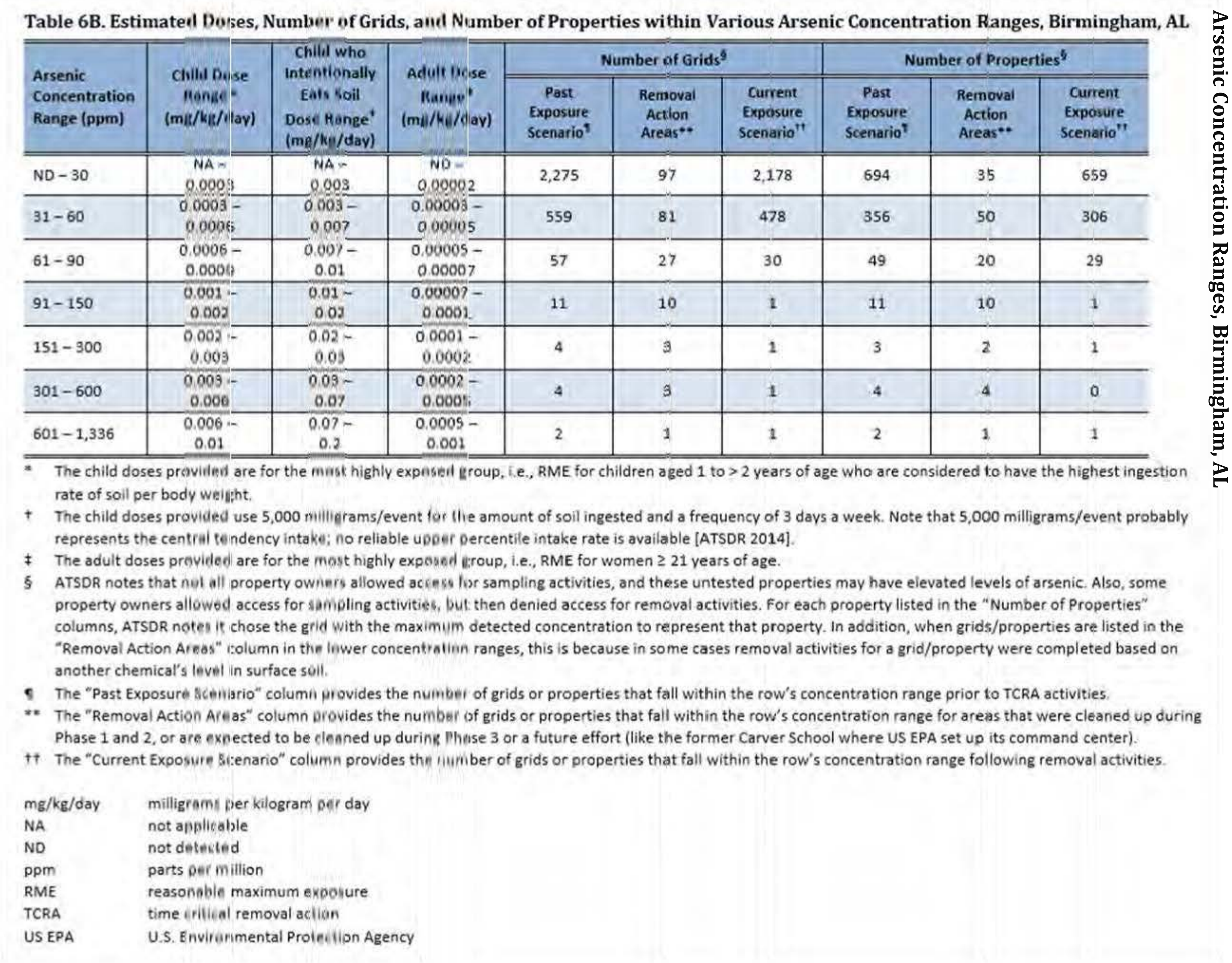


Table 6B. Estimated Doses, Number of Grids, and Number of Properties within Various Arsenic Concentration Ranges, Birmingham, AL

Arsenic Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND – 30	NA – 0.0003	NA – 0.003	ND – 0.00002	2,275	97	2,178	694	35	659
31 – 60	0.0003 – 0.0006	0.003 – 0.007	0.00003 – 0.00005	559	81	478	356	50	306
61 – 90	0.0006 – 0.0009	0.007 – 0.01	0.00005 – 0.00007	57	27	30	49	20	29
91 – 150	0.001 – 0.002	0.01 – 0.02	0.00007 – 0.0001	11	10	1	11	10	1
151 – 300	0.002 – 0.003	0.02 – 0.03	0.0001 – 0.0002	4	3	1	3	2	1
301 – 600	0.003 – 0.006	0.03 – 0.07	0.0002 – 0.0005	4	3	1	4	4	0
601 – 1,336	0.006 – 0.01	0.07 – 0.2	0.0005 – 0.001	2	1	1	2	1	1

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of arsenic. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following removal activities.

mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	time critical removal action
US EPA	U.S. Environmental Protection Agency

Table 7B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges, Birmingham, AL (page 1 of 2)

Lead Concentration Range (ppm)	Estimated Probability (%) of exceeding a BLL of 5 µg/dL	Estimated Geometric Mean BLL (µg/dL)	Number of Grids*			Number of Properties*		
			Past Exposure Scenario[†]	Removal Action Areas[‡]	Current Exposure Scenario[§]	Past Exposure Scenario[†]	Removal Action Areas[‡]	Current Exposure Scenario[§]
ND – 100	NA – 1.5	NA – 1.8	1,044	30	1,014	173	4	169
101 – 200	1.5 – 10[¶]	1.8 – 2.7	1,091	50	1,041	393	18	375
201 – 300	10 – 25	2.7 – 3.6	362	20	342	184	14	170
301 – 400	25 – 40	3.6 – 4.5	186	12	174	114	11	103
401 – 600	41 – 66	4.5 – 6.1	177	45	132	118	25	93
601 – 800	66 – 81	6.1 – 7.6	84	11	73	71	7	64
801 – 1,000	81 – 89	7.6 – 8.9	25	8	17	18	2	16
1,001 – 2,000	89 – 99	8.9 – 15	38	27	11	32	22	10
2,001 – 3,000	99 – 100	15 – 19	10	10	0	9	9	0
3,001 – 27,000	100 – NA**	19 – NA**	11	11	0	10	10	0

* ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of lead. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it choose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are indicated in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

† The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

‡ The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

§ The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following removal activities.

¶ For example, the value of 10 means 10% of the BLLs are estimated to be ≥ 5 µg/dL.

** At elevated soil lead concentrations, the IEUBK model provides a warning that the predicted blood lead levels (> 30 µg/dL) are above the range of values that were used in the calibration and empirical validation of the model [USEPA 2002a]. Therefore, EPA states the model should not be relied upon to predict BLLs above 30 µg/dL [USEPA 2002a, 2002b].

BLL	blood lead level
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
µg/dL	micrograms per deciliter
NA	not applicable

Table 7B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges, Birmingham, AL (page 2 of 2)

ND	not detected
ppm	parts per million

Table 8B. Estimated Doses, Number of Grids, and Number of Properties within Various BaP TE Concentration Ranges, Birmingham, AL

BaP TE Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND – 0.5	NA – 9E-06	NA – 9E-05	NA – 7E-07	2,272	68	2,204	691	31	660
0.6 – 1.0	1E-05 – 2E-05	1E-04 – 2E-04	8E-07 – 1E-06	400	31	369	203	18	185
1.1 – 1.5	2E-05 – 3E-05	2E-04 – 3E-04	2E-05 – 2E-06	136	17	119	77	8	69
1.6 – 3.0	3E-05 – 5E-05	3E-04 – 6E-04	2E-06 – 4E-06	118	34	84	79	13	66
3.1 – 5.0	5E-05 – 9E-05	6E-04 – 9E-04	4E-06 – 7E-06	43	29	14	31	20	11
5.1 – 7.5	9E-05 – 1E-04	1E-03 – 1E-03	7E-06 – 1E-05	15	12	3	13	10	3
7.6 – 322	1E-04 – 6E-03	1E-03 – 6E-02	1E-05 – 4E-04	39	32	7	28	22	6

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated BaP TE levels. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following removal activities.

BaP TE	benzo(a)pyrene toxic equivalent
mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 8B. Estimated Doses, Number of Grids, and Number of Properties within Various BaP TE Concentration Ranges, Birmingham, AL

Table 9B. Estimated Doses, Number of Grids, and Number of Properties within Various Dibenz(ah)anthracene Concentration Ranges, Birmingham, AL

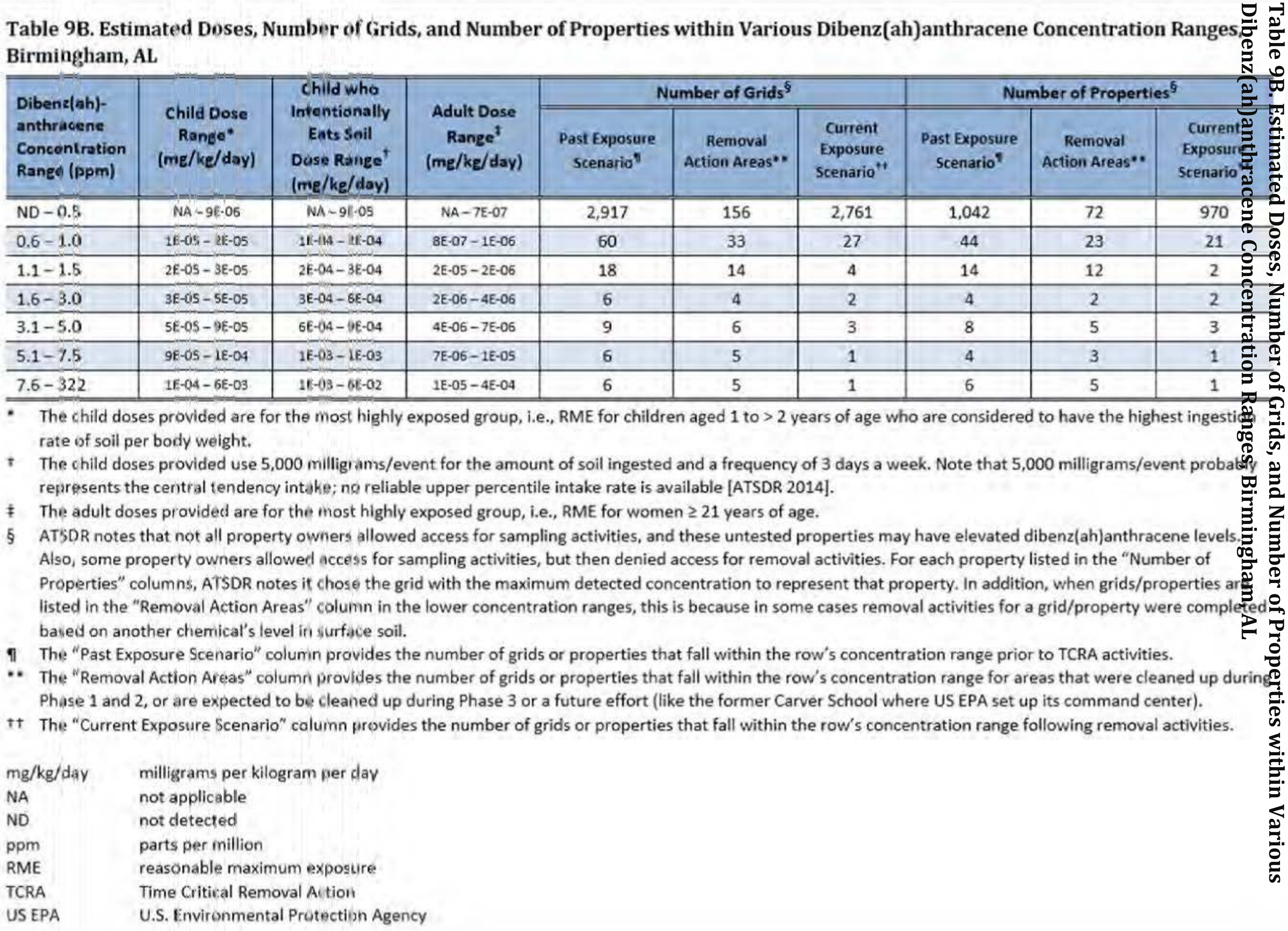


Table 9B. Estimated Doses, Number of Grids, and Number of Properties within Various Dibenz(ah)anthracene Concentration Ranges, Birmingham, AL

Dibenz(ah)-anthracene Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND – 0.5	NA – 9E-06	NA – 9E-05	NA – 7E-07	2,917	156	2,761	1,042	72	970
0.6 – 1.0	1E-05 – 2E-05	1E-04 – 2E-04	8E-07 – 1E-06	60	33	27	44	23	21
1.1 – 1.5	2E-05 – 3E-05	2E-04 – 3E-04	2E-05 – 2E-06	18	14	4	14	12	2
1.6 – 3.0	3E-05 – 5E-05	3E-04 – 6E-04	2E-06 – 4E-06	6	4	2	4	2	2
3.1 – 5.0	5E-05 – 9E-05	6E-04 – 9E-04	4E-06 – 7E-06	9	6	3	8	5	3
5.1 – 7.5	9E-05 – 1E-04	1E-03 – 1E-03	7E-06 – 1E-05	6	5	1	4	3	1
7.6 – 322	1E-04 – 6E-03	1E-03 – 6E-02	1E-05 – 4E-04	6	5	1	6	5	1

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated dibenz(ah)anthracene levels. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phase 1 and 2, or are expected to be cleaned up during Phase 3 or a future effort (like the former Carver School where US EPA set up its command center).

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following removal activities.

mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 10B. Default Exposure Assumptions

Group	Soil Intake (mg/day)		Exposure Frequency	Body Weight (kg)	Exposure Duration for Cancer Risk (years)
	RME	CTE			
Child 6 weeks to < 1 year	100	60	1	9.2	0.88
Child 1 to < 2 years	200	100	1	11.4	1
Child 2 to < 6 years	200	100	1	17.4	4
Child 6 to < 11 years	200	100	1	31.8	5
Child 11 to <16 years	200	100	1	56.8	5
Child 16 to <21 years	200	100	1	71.6	5
Child (who intentionally eats soil) 1 < 2 years	NA	5,000	0.429*	11.4	NA
Child (who intentionally eats soil) 2 < 6 years	NA	5,000	0.429*	17.4	NA
Adults ≥ 21 years	100	50	1	80	33
Men ≥ 21 years	100	50	1	85	54
Women ≥ 21 years	100	50	1	75	59
Gardener ≥ 21 years	NA	100	1	80	33

Source: ATSDR 2014.

* Assumes a frequency of 3 days a week.

CTE	central tendency exposure
kg	kilogram
mg	milligram
NA	not applicable
RME	reasonable maximum exposure

Table 11B. Possible Sources of Lead Exposures

Place	Source
Indoors	**Paint** – Ingesting paint chips primarily found in homes built prior to 1978 and on older toys and furniture.
	Dust – Ingesting dust (from hand-to-mouth activity) found in older homes (built prior to 1978) or tracked in from contaminated soil.
	Water – Drinking water containing lead that comes from corrosion of older fixtures, from the solder that connects pipes, or from wells where lead contamination has affected the groundwater.
	Tableware – Eating foods from imported, old, handmade, or poorly glazed ceramic dishes and pottery that contains lead. Lead may also be found in leaded crystal, pewter, and brass dishware.
	Candy – Eating consumer candies imported from Mexico. Certain candy ingredients such as chili powder and tamarind may be a source of lead exposure. Candy wrappers have also been shown to contain some lead.
	Toy Jewelry – Swallowing or putting in the mouth toy jewelry that contains lead. This inexpensive children's jewelry is generally sold in vending machines and large volume discount stores across the country.
	Traditional (folk) Medicines –Ingesting some traditional (folk) medicines used by India, Middle Eastern, West Asian, and Hispanic cultures. Lead and other heavy metals are put into certain folk medicines on purpose because these metals are thought to be useful in treating some ailments. Sometimes lead accidentally gets into the folk medicine during grinding, coloring, or other methods of preparation.
Outdoors	**Outdoor Air** – Breathing lead particles in outdoor air that comes from the residues of leaded gasoline or industrial operations.
	Soil – Ingesting dirt contaminated with lead that comes from the residues of leaded gasoline, industrial operations, or lead-based paint.
Other	**Hobbies** – Ingesting lead from hobbies using lead such as welding, auto or boat repair, the making of ceramics, stained glass, bullets, and fishing weights. Other hobbies that might involve lead include furniture refinishing, home remodeling, painting and target shooting at firing ranges.
	Workplace – Ingesting lead found at the workplace. Jobs with the potential for lead exposure include building demolition, painting, remodeling/renovation, construction, battery recycling, radiator repair, and bridge construction. People who work in a lead environment may bring lead dust into their car or home on their clothes and bodies exposing family members.

Sources: CDC 2009; NYDOH 2010.

Table 12B. Descriptive Statistics for 35th Avenue Blood Lead Testing (July 2013), Birmingham, AL

Descriptive Statistics*		Children 1–5 years of age	Children 6–11 years of age	Children 12–19 years of age	20 years of age and older
Number of people		13	23	6	2
Blood Lead Level (µg/dL)	Maximum	3	3	1	1
	75th percentile	2	1	1	1
	Median	1	1	1	1
	25th percentile	1	1	1	1
	Minimum	1	0	0	1
	Interquartile range	1	0	0	0
	Geometric Mean[†]	1.4	0.64	0.32	1
	95% confidence interval on the geometric mean[†]	1.1 – 1.9	0.27 – 1.5	0.032 – 3.0	1 – 1

Data Source: JCDH 2013.

[*] The blood lead level data provided to ATSDR were integer values.

[†] The geometric means and associated confidence intervals are approximations when an age group contains minimum BLL values of zero.

BLL	blood lead level
µg/dL	micrograms per deciliter

Table 13B. Descriptive Statistics for 2010–2014 BLL data for children ≤ 21 years of age in ZIP code 35207, Birmingham, AL

Descriptive Statistics*		Children 1–5 years of age	Children 6–11 years of age	Children 12–19 years of age	Children 20–21 years of age
Number of children		329	214	16	1
Blood Lead Level (µg/dL)	Maximum	16	10	4	3
	75th percentile	3	3	3	3
	Median	2	2	3	3
	25th percentile	1	1	2	3
	Minimum	0	1	1	3
	Interquartile range	2	2	1	0
	Geometric Mean†	1.7	1.9	2.4	3
	95% confidence interval on the geometric mean†	1.6 – 1.9	1.7 – 2.0	2.0 – 2.9	NA
Number children with BLL ≥ 5 µg/dL (reference level‡)		16	9	0	0

Data Source: ATSDR 2015.

* The blood lead level data provided to ATSDR were integer values.

† The geometric means and associated confidence intervals are approximations when an age group contains minimum BLL values of zero.

‡ The reference level is based on the highest 2.5% of the U.S. population of children 1-5 years of age. This level is currently 5 µg/dL and based on the 2009-2010 National Health and Nutrition Examination Survey.

BLL	blood lead level
µg/dL	micrograms per deciliter
NA	not applicable

Appendix C. Ways to Protect your Health

Ways to protect your health

By keeping dirt from getting into your house and into your body

Wash and peel all fruits, vegetables, and root crops

Wipe shoes on doormat or remove shoes

Don't eat food, chew gum, or smoke when working in the yard

Damp mop floors and damp dust counters and furniture regularly

Wash dogs regularly

Wash children's toys regularly

Wash children's hands and feet after they have been playing outside

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Appendix D. Ways to Prevent High Levels of Lead in Blood

Children and the developing fetus of pregnant women are at higher risk of developing health effects caused by exposure to high levels of lead than adults. When too much lead builds up in a child’s body, it can cause learning, hearing, and behavioral problems and can harm your child’s brain, kidneys, and other organs. Some of these health effects can last a lifetime. Tests are available to let people know how much lead is in their blood.

Ways to prevent high levels of lead in blood include

☑ **Eating 3 healthy meals a day and at least 2 healthy snacks.**

Eating healthy meals can help lower, but not eliminate, the risk of getting high levels of lead in blood. People with empty stomachs get more lead into their bodies than people with full stomachs.

☑ **Eating a balanced diet.**

People’s bodies are less likely to absorb lead when their diet is rich in nutrients and vitamins.

- Eat iron-rich foods like
    - Lean red meats, fish or chicken
    - Cereals high in iron
    - Dried fruits such as raisins or prunes
- Eat calcium-rich foods like
    - Milk, yogurt, cheese
    - Green leafy vegetables (spinach, kale, collard greens)
- Eat foods high in Vitamin C like
    - Oranges or orange juice and grapefruits or grapefruit juice
    - Tomatoes, tomato juice
    - Green peppers

☑ **Eating less high fat and fried foods.**

People’s bodies are more likely to absorb lead when they eat high fat and fried foods.

- Avoid foods like hot dogs, French fries, and potato chips

☑ **Washing your hands before fixing food and washing and peeling produce before eating it.**

Lead particles that stick to people’s hands after gardening and to the surface of garden produce can be washed away before the lead enters a person’s body.

☑ **Using only cold water from the tap for drinking, cooking, and for making baby formula.**

Hot water is more likely to contain lead. Run cold water 30 to 60 seconds before using it.

Appendix E. How to Prevent Lead Exposure at Home

How to Prevent Lead Exposure at Home

Parents can take simple steps to make their homes more lead-safe.

- Talk to your local health department about testing paint and dust in your home for lead if you live in a home built before 1978.
- Common home renovation activities like sanding, cutting, and demolition can create hazardous lead dust and chips by disturbing lead-based paint. These can be harmful to adults and children.
- Renovation activities should be performed by certified renovators who are trained by EPA-approved training providers to follow lead-safe work practices.
- Learn more at EPA's Renovation, Repair, and Painting rule Web page: http://www.epa.gov/lead/pubs/renovation.htm.
- If you see paint chips or dust in windowsills or on floors because of peeling paint, clean these areas regularly with a wet mop.
- Wipe your feet on mats before entering the home, especially if you work in occupations where lead is used. Removing your shoes when you are entering the home is a good practice to control lead.
- Use only cold water from the tap for drinking, cooking, and for making baby formula. Hot water is more likely to contain lead. Run cold water 30 to 60 seconds before using it.
- Remove recalled toys and toy jewelry from children. Stay up-to-date on current recalls by visiting the Consumer Product Safety Commission’s Web site: http://www.cpsc.gov/.

Lead can be found in a variety of sources.

These include:

- paint in homes built before 1978
- water pumped through leaded pipes
- imported items including clay pots.
- certain consumer products such as candies, make -up and jewelry
- certain imported home remedies

Appendix F. Derivation and Intended Use of Comparison Values

The Agency for Toxic Substances and Disease Registry (ATSDR) has developed health and environmental guidelines to use when conducting the screening analysis and evaluating exposures to substances found at sites under investigation. The information provided in this appendix was compiled directly from ATSDR's Public Health Assessment Guidance Manual [ATSDR 2005]. The purpose of this appendix is to provide information about those health and environmental guidelines used for screening purposes in the 35th Avenue Public Health Consultation. For further information on ATSDR's public health assessment process and comparison values, please refer to the ATSDR guidance manual available at http://www.atsdr.cdc.gov/hac/PHAManual/toc.html.

ATSDR, in cooperation with the U.S. Environmental Protection Agency (US EPA), has developed a priority list of hazardous substances found at hazardous waste sites, as directed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendment and Reauthorization Act of 1986 (SARA). For those substances most commonly found, ATSDR has prepared Toxicological Profiles that include an examination, summary, and interpretation of available toxicologic and epidemiologic data. Using those data, ATSDR has derived health and environmental guidelines.

- ATSDR ***health guidelines*** are substance-specific doses or concentrations derived using toxicologic information. Where adequate dose-response data exist, health guidelines are derived for both the ingestion or inhalation routes of exposure. Health guidelines include ATSDR's minimal risk levels (MRLs). No health guidelines have been developed by ATSDR for dermal exposures.
- ATSDR ***environmental guidelines*** are media-specific substance concentrations derived from health guidelines using default exposure assumptions. ATSDR environmental guidelines include environmental media evaluation guides (EMEGs) and cancer risk evaluation guides (CREGs) that are available for contact with substances in water, soil, and air. No environmental guidelines have been developed by ATSDR for contact with contaminants in food or biota.

ATSDR health and environmental guidelines discussed in this appendix are MRLs, EMEGs, and CREGs. For each guideline discussed, a definition and description of the derivation and applicability or intended use are provided.

1D. Minimal Risk Levels (MRLs)

ATSDR's minimal risk levels (MRLs) are an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a specified duration of exposure. MRLs are based only on noncarcinogenic effects. MRLs are screening values only and are not indicators of health effects. Exposures to substances at doses above MRLs will not necessarily cause adverse health effects and should be further evaluated.

ATSDR derives MRLs when reliable and sufficient data can identify the target organ(s) of effect or the most sensitive health effects(s) for a specific duration for a given route of exposure. MRLs are set below levels that might cause adverse health effects in most people, including sensitive populations. MRLs are derived for acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) durations. MRLs are generally based on the most sensitive chemical-induced endpoint considered relevant to humans. ATSDR does not use serious health endpoints (e.g., irreparable damage to the liver or kidneys, birth defects) as bases for establishing MRLs.

MRL Derivation

MRL = NOAEL (or LOAEL) / UF

where,

MRL = minimal risk level (mg/kg/day)
NOAEL = no-observed-adverse-effect level (mg/kg/day)
LOAEL = lowest-observed-adverse-effect level (mg/kg/day)
UF = uncertainty factor (unitless)

ATSDR derives MRLs for substances by factoring the most relevant documented no-observed-adverse-effects level (NOAEL) or lowest-observed-adverse-effects level (LOAEL) and an uncertainty factor. The specific approach used to derive MRLs for individual substances are detailed in ATSDR's Toxicological Profile for each substance available at http://www.atsdr.cdc.gov/toxprofiles/index.asp.

Most MRLs contain a degree of uncertainty because of the lack of precise toxicologic information about the people who might be most sensitive to the effects of environmental contamination (e.g., children, elderly, those with pre-existing illnesses). ATSDR uses a conservative (i.e., protective) approach to address this uncertainty. This approach is consistent with the public health principle of prevention.

Although human data are preferred, when relevant human studies are unavailable, ATSDR bases MRLs on animal studies. In the absence of evidence to the contrary, ATSDR assumes that humans are more sensitive to the effects of hazardous substances than are animals and that certain persons might be particularly sensitive. Uncertainties are taken into account by applying “uncertainty factors” to the NOAEL. For example, an uncertainty factor of between 1 and 10 might apply for extrapolation from animal doses to human doses or to account for sensitive persons. When more than one uncertainty factor is applied, the uncertainty factors are multiplied. For example, the combined uncertainty factor of 100 could be accounted for by an uncertainty factor of 10 for the extrapolation of animals to humans and another factor of 10 to account for sensitive persons.

ATSDR derives MRLs on the assumption that exposures occur to a single substance and that only noncarcinogenic health effects might result. But hazardous waste sites might expose people to a mixture of substances. MRLs are intended to serve only as a screening tool to help ATSDR staff decide whether to evaluate more closely exposures to a substance found at a site. MRLs are not intended to define cleanup or action levels. And exposure doses above the MRL do not necessarily mean that adverse health effects will occur.

2D. Environmental Media Evaluation Guides (EMEGs)

ATSDR’s environmental media evaluation guides (EMEGs) represent concentrations of substances in water, soil, and air to which humans might be exposed during a specified period of time (acute, intermediate, or chronic) without experiencing adverse health effects. EMEGs have been calculated for substances for which ATSDR has developed Toxicological Profiles. ATSDR uses information about the substance toxicity (MRLs) and default exposure assumptions.

ATSDR uses EMEGs during a screening analysis, particularly when conducting an environmental guideline comparison. Substances found at concentrations below EMEGs are not expected to pose public health hazards. Substances found at concentrations above EMEGs require further evaluation before arriving at a public health conclusion. EMEGs are screening values only—they are not indicators of adverse public health effects. Substances found at concentrations above EMEGs will not necessarily cause adverse health effects, but will require further evaluation.

ATSDR makes three assumptions when deriving EMEGs: 1) exposures occur through contact with a single medium (e.g., water or soil) via a single route (e.g., ingestion or inhalation), 2) exposures involve a single substance, and 3) from the exposure, only noncarcinogenic health effects might result.

EMEGs are based on toxicity information (MRLs), which consider noncarcinogenic toxic effects of chemicals, including their developmental and reproductive toxicity. MRLs do not consider potential genotoxic or carcinogenic effects of a substance. Because some substances have both noncarcinogenic and carcinogenic effects, ATSDR has derived cancer risk evaluation guides (CREGs) to consider potential carcinogenic effects of a substance.

To derive the soil EMEGs, ATSDR uses the chronic oral MRLs from its Toxicological Profiles. Many chemicals bind tightly to organic matter or silicates in the soil. Therefore, the bioavailability of a chemical is dependent on the media in which it is administered. Ideally, an MRL for deriving a soil EMEG should be based on an experiment in which the chemical was administered in soil. However, data from this type of study is seldom available. Therefore, often ATSDR derives soil EMEGs from MRLs based on studies in which the chemical was administered in drinking water, food, or by gavage using oil or water as the vehicle. The Toxicological Profiles for individual substances provide detailed information about the MRL and the experiment on which it was based.

Children are usually assumed to be the most highly exposed segment of the population because their soil ingestion rate is greater than adults' rate. Experimental studies have reported soil ingestion rates for children ranging from approximately 40 to 270 milligrams per day (mg/day), with 100 mg/day representing the best estimate of the average intake rate. ATSDR calculates an EMEG for a child using a daily soil ingestion rate of 200 mg/day for a 10-kg child.

For sites where the only receptors for soil ingestion are adults, an EMEG is calculated using an adult body weight of 70 kilograms and an assumed daily soil ingestion rate of 100 mg/day. There are very few data on soil ingestion by adults, but limited experimental studies suggest a soil ingestion rate in adults of up to 100 mg/day, with an average intake of 50 mg/kg. Concentrations of substances in soil are expressed as milligrams per kilogram (mg/kg) or ppm.

3D. Cancer Risk Evaluation Guides (CREGs)

ATSDR’s cancer risk evaluation guides (CREGs) are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population. ATSDR develops CREGs using US EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents a possible risk of one excess cancer case in a population of one million. CREGs are only available for adult exposures—no CREGs specific to childhood exposures are available.

To derive soil CREGs, ATSDR uses CSFs developed by US EPA and reported in the Integrated Risk Information System (IRIS). The IRIS summaries, available at http://www.epa.gov/iris/ , provide detailed information about the derivation and basis of the CSFs for individual substances. ATSDR derives CREGs for lifetime exposures, and therefore uses exposure parameters that represent exposures as an adult. An adult is assumed to ingest 100 mg/day of soil and weigh 70 kg.

In developing the CREGs, ATSDR assumes that 1) exposures occur through contact to a single medium, (2) exposures occur to a single substance, and 3) from the exposure only cancer health effects will result. CREGs serve as a screening tool for evaluating concentrations of carcinogens during an environmental guideline comparison. CREGs are based on possible estimates of cancer risk. Therefore, CREGs should serve only as a screening tool and not that cancer is indicated, expected, or predicted.

4D. Reference

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005. Public health assessment guidance manual (update). Atlanta: US Department of Health and Human Services.

Exhibit B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION 4

61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

February 12, 2013

MEMORANDUM

SUBJECT: Recommendations for Use of XRF and Sieving of Soils
35th Avenue Superfund Site, Birmingham, Alabama

FROM: Glenn Adams, Chief
Technical Services Section
Superfund Support Branch

TO: Jeffery Crowley, On-Scene Coordinator,
Emergency Response and Removal Branch

As you have requested, the Technical Services Section (TSS) has reviewed the data you provided. We reviewed the results of lead and arsenic data comparing laboratory data to XRF data and/or the data from soil samples that were sieved and unsieved. Currently, the sampling and analysis protocol being followed at the 35th Avenue site is to take XRF readings of all samples and then sieve the sample and take another XRF reading and then send 10% of samples to a laboratory for lab analysis. This review was to help determine if sieving and laboratory analysis at this level is still needed. Below are TSS's recommendations after doing a statistical analysis of this data and concentrating on the specific data points close to the Removal Management Levels (RMLs) for lead and arsenic.

TSS has reviewed the data provided by the OSC and based on our review and the statistical analysis performed (see attached analysis), data within +/- 200 mg/kg of the lead RML, the lab and XRF data are positively correlated (correlation coefficient = 0.74). There was a similarly strong correlation between the sieved and un-sieved data (correlation coefficient = 0.74).

Just looking at the statistical analysis of this data, it could be concluded that sieveing and laboratory data may not be necessary to make removal decisions with a reasonable degree of confidence. Yet when you focus on the lead data in these comparisons just above or just below the RMLs and determine if the differences in the sample preparation and/or data analysis would have resulted in a different decision for some residential yards. There is data that would show exceedances of RMLs in the lab data and/or sieved data that are not shown when just using the XRF and/or un-sieved data.

The issues identified with the use of XRF and un-sieved arsenic data seem to be present in XRF results above the RML and just above and just below the RML for lead data. Since each of these data points typically represent all or part of a residential yard, more consideration needs to be given to the raw data than just using the statistical analysis alone. TSS recommends the following procedures to provide a higher level of confidence in the data used for decision making.

Recommendations for future Lead and Arsenic data/samples: Based on the data and the observations stated above, TSS recommends that any samples with XRF readings of lead between 200 mg/Kg and 600 mg/Kg should be sieved and sent to the lab for metals analysis. For arsenic, any XRF readings above 40 mg/Kg should be sieved and sent to the lab for metals analysis. The exception for arsenic can be when you have XRF lead data above 600 mg/Kg in the same sample, no further arsenic data typically would be needed because of the high lead concentrations which would drive the cleanup already. Typically, the sieved and lab data should be used as the main data set for your decision making, but there may be site specific situations that alter the typical procedure.

TSS recommends that lead concentrations in un-sieved samples greater than 600 mg/Kg and less than 200 mg/Kg can be used without needing to be sieved or sent to the lab. TSS also recommends that un-sieved samples with arsenic concentrations less than 40 mg/Kg can be used without needing to be sieved or sent to the lab.

Please let me know if you have any questions or if there is anything additional you need. We can be available for a conference call to discuss this information at your convenience. You can reach me at 404-562-8771 if you have any questions.

ATTACHMENT

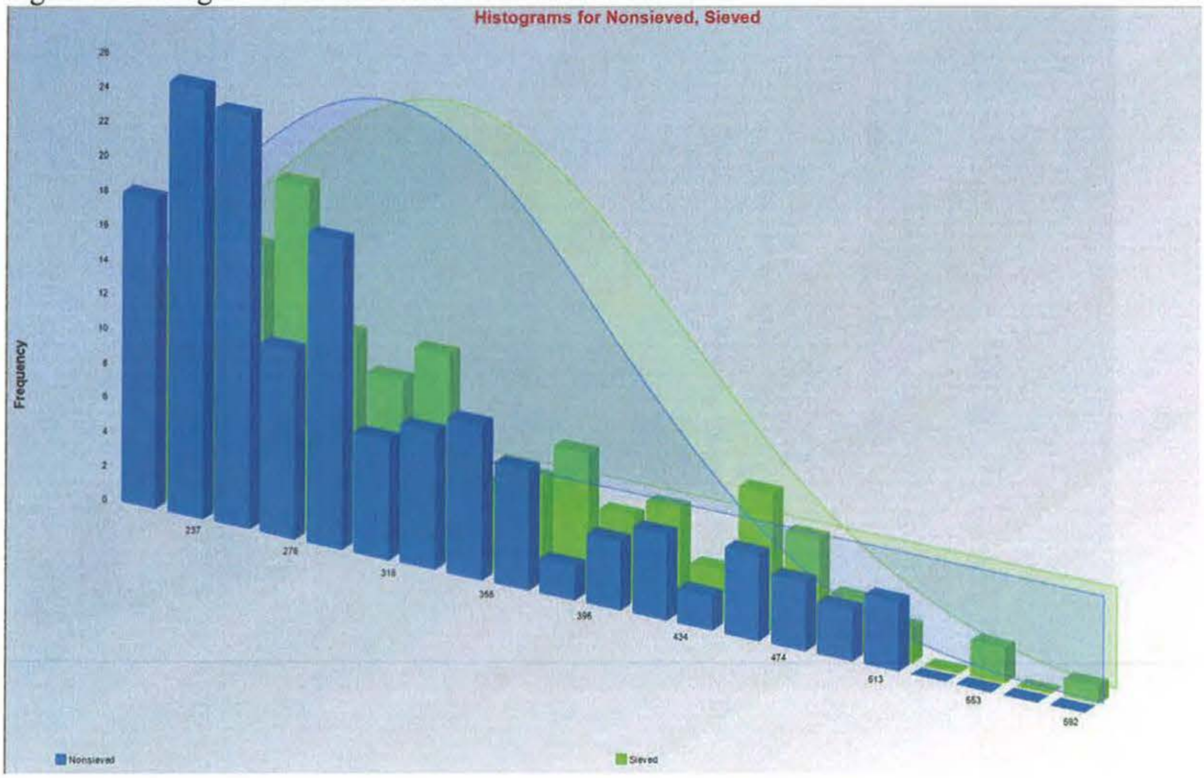
Summary statistics are presented in Table 1for the un-seived and sieved soil lead data. The summary data show that the measures of central tendency (mean/median) are similar and that the coefficients of variation, a measure of variability within each data set, are essentially identical for the data sets.

Table 1. Summary statistics for unsieved and sieved lead data sets.

Variable	N =	Mean	Median	CV
Un-Sieved	156	306	280	0.285
Sieved	156	325	296	0.29

A histogram of the two data sets shows that the distribution of the lead data sets appears to be very similar. (Figure 1)

Figure 1. Histograms of sieved and unsieved lead data sets.



Summary statistics are presented in Table 2 for the XRF and laboratory soil lead data. The summary data show that the measures of central tendency (mean/median) are higher for the samples analyzed in the lab. The coefficients of variation, a measure of variability within each data set, however are very similar for the data sets.

Table 2. Summary statistics for XRF and lab lead data sets.

Variable	N =	Mean	Median	CV
Lab	34	395	410	0.257
XRF	34	348	325	0.279

A histogram of the two data sets shows that the distribution of the data appears to have a similar shape, but the lab data are shifted slightly higher. (Figure 2) It is possible that these data would more closely mirror one another if the number of data points increased.

Figure 2. Histograms of lab and XRF lead data sets.

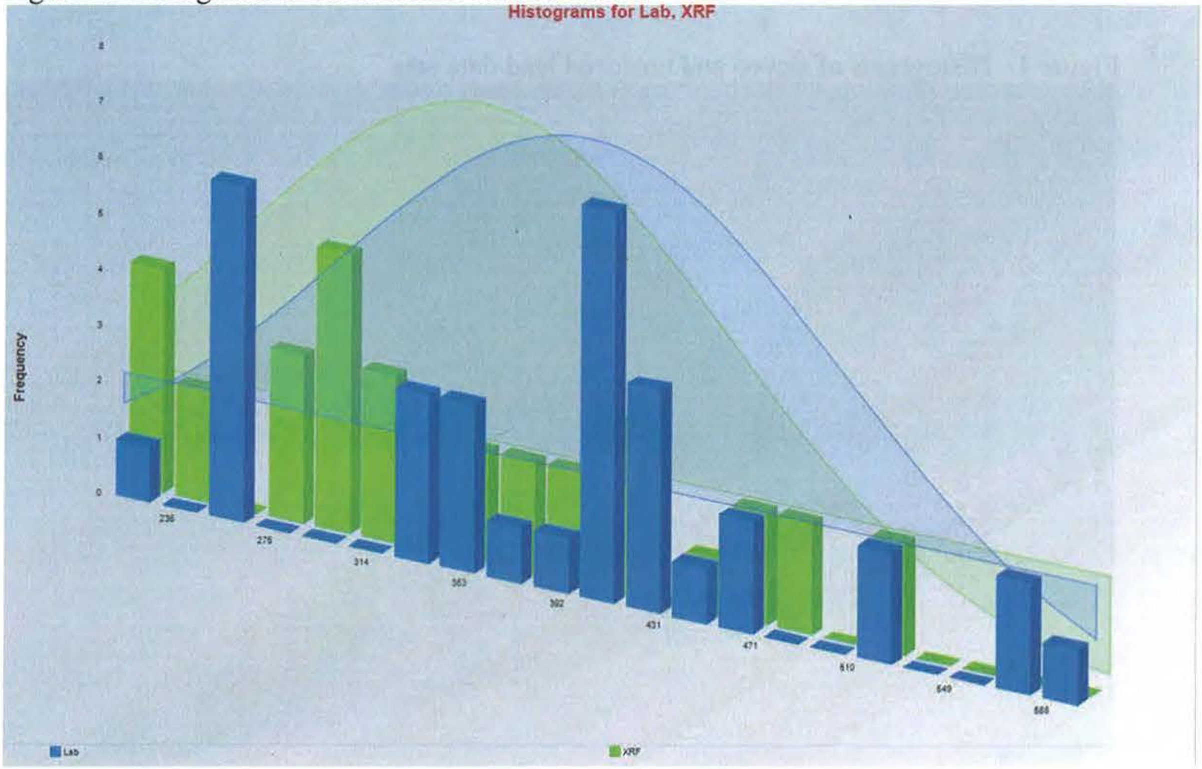
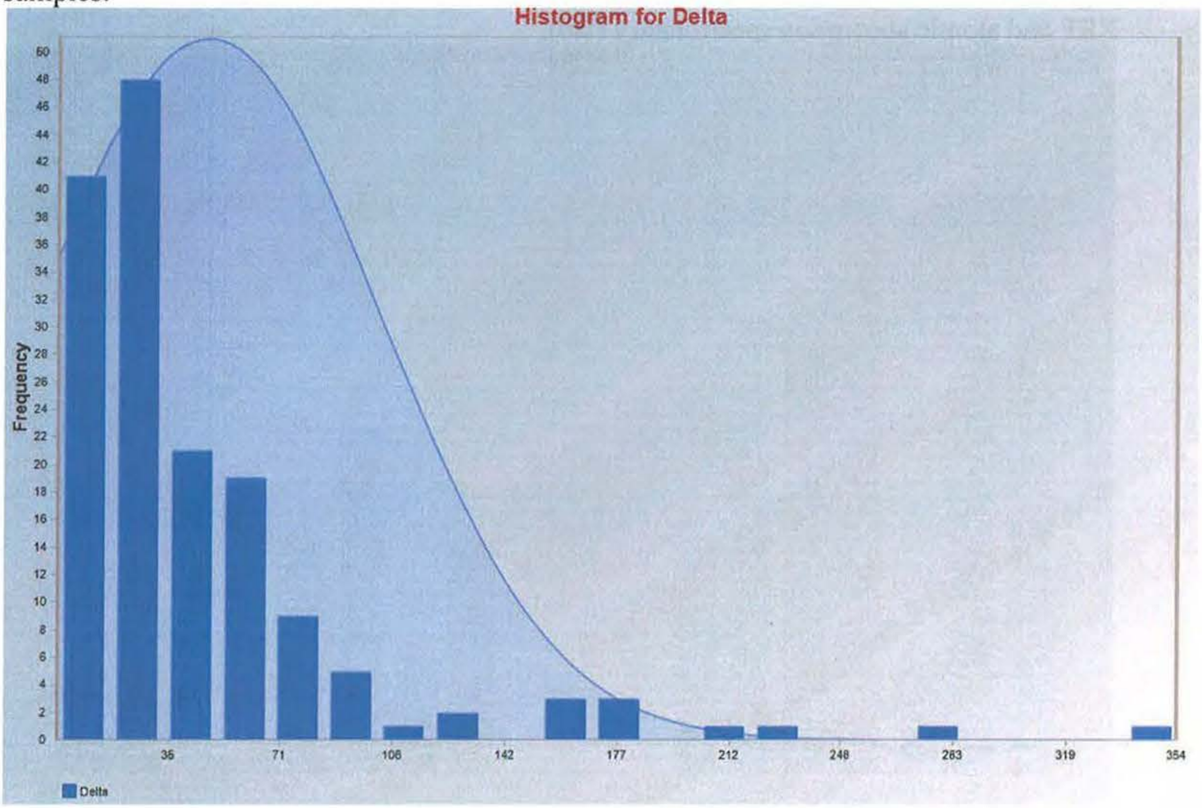


Figure 3 is a histogram of the absolute difference (delta) between the sieved and unsieved soil sample lead concentration data (n=156). The histogram shows that the difference was less than (+/-) 200 mg/kg in all but four samples. (Figure 3)

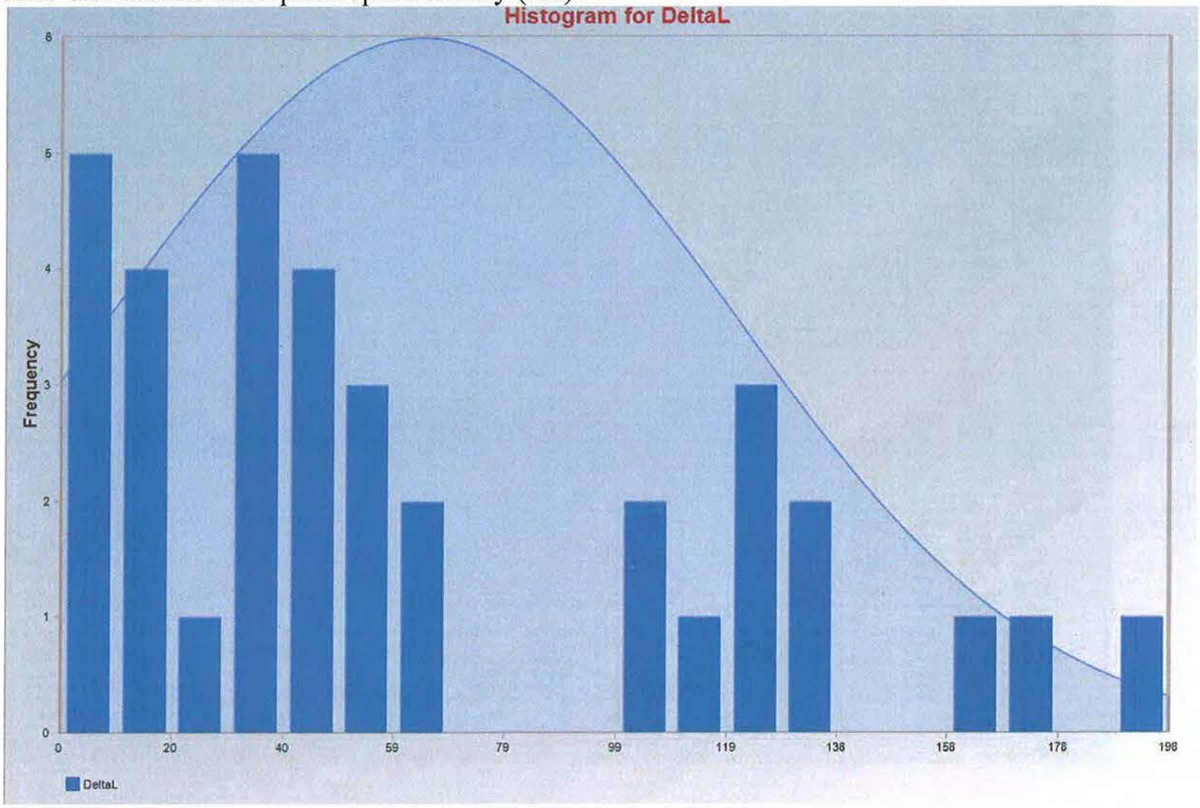
Figure 3. Absolute difference (delta) in lead concentrations the sieved and unsieved soil samples.



The data were also evaluated to determine when a potentially different decision would result depending on the type of sample preparation. In cases where the unsieved sample resulted in a concentration > 400 mg/kg of lead, there were only six instances where the corresponding sieved sample resulted in a concentration less than 400 mg/kg. In cases where the sieved samples were > than 400 mg/kg, there were fifteen instances where the unsieved sample was less than 400 mg/kg.

Figure 4 is a histogram of the absolute difference (delta) between samples analyzed in the field (XRF) and soil samples analyzed in the lab. The histogram shows that the difference was less than (+/-) 200 mg/kg in all sample pairs. (Figure 4)

Figure 4. Absolute difference (delta) in lead concentrations between samples analyzed by XRF and atomic absorption spectrometry (lab).



The data were also evaluated to determine when a potentially different decision would have been made depending on the type of sample analysis. In cases where the lab sample resulted in a concentration > 400 mg/kg of lead, there were ten instances where the corresponding XRF sample resulted in a concentration less than 400 mg/kg. In cases where the XRF samples were greater than 400 mg/kg, the corresponding lab sample was less than 400 mg/kg in only a single sample. .

Exhibit C

KAZMAREK MOWREY CLOUD LASETER LLP
ENVIRONMENTAL & ENERGY LAW

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January 31, 2014

Via Email

Marianne Lodin, Esq.
U.S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, GA 30303

Re: 35th Avenue Superfund Site

Dear Marianne,

This letter follows up EPA's January 16 meeting on the 35th Avenue Site. EPA requested comments on the draft Administrative Order on Consent (AOC) provided for the first time during that meeting. This letter provides Walter Coke comments on the AOC, and on the process that surrounds it and related issues. This letter is being submitted as soon as practicable in light of the recent extraordinary weather issues in the Southeast.

I. Walter Coke's interest in participating in an AOC.

Walter Coke understands that the purpose of providing the draft AOC at the January 16 meeting was to present private parties EPA has thus far identified as PRPs the opportunity to enter an agreement to lead Phase 1 of the removal action that EPA believes is warranted. Since EPA itself acknowledged that coming to terms on any such agreement by EPA's February 12 date is "completely unrealistic," we understand that EPA's goal is to induce private parties to assume, under an AOC, the work the Agency itself intends to commence in February. Regrettably, only two of the five PRPs thus far identified by EPA were willing to attend the January 16 meeting, making an already challenging situation even more so. Despite its significant concerns on a number of issues identified in this and previous correspondence, and without any admission of any kind, Walter Coke remains interested in attempting to work with EPA toward an eventual private party takeover of the work by a reasonable initial critical mass of PRPs.

For context, for several years Walter Coke has cooperated with EPA to a greater degree than might reasonably be expected under the circumstances. In particular:

- The company agreed to EPA's 2005 request for off-site sampling, despite the lack of any specific rationale for suspecting off-site contamination associated with the facility;

- The company agreed again to expand off-site sampling in 2009 at EPA's request, using sampling protocols and locations directed by EPA, again with no evidence presented tying Walter Coke to any off-site contaminants;

- The company agreed to conduct soil removal work at 23 yards, and conducted that work at the 16 locations where access was granted. The company also conducted soil removal work at 2 schools. That work resulted in additional specific information presented to the agency clearly demonstrating the company's assertion that EPA claims that Walter Coke operations and air deposition accounted for elevated contaminant levels were unsupported; EPA has never responded to or rebutted to this information; and

- Despite that fact and the fact that EPA subsequently declined to abide by its own sampling rationale for the 2005 and 2009 sampling, and declined to utilize the EPA-approved sampling results, the company worked exhaustively with EPA to develop the sampling plan ultimately used in whole or in substantial part by EPA in 2012-2013 in the communities. Walter Coke also worked diligently with EPA to develop a consent order under which it would participate in that sampling, and was only unable to enter that consent order when EPA failed to follow through on the single issue Walter Coke made clear was critical to its participation—EPA's commitment to timely identify other PRPs.

All told, Walter Coke, unlike any other industry in the area, has already expended substantial financial and other resources to address EPA and community concerns.

II. Comments on lack of liability nexus as to Walter Coke and on EPA PRP identification.

Below are Walter Coke's comments on EPA's claimed liability case as to Walter Coke. While Walter Coke remains prepared to attempt to reach agreement with EPA and other PRPs, that fact reflects Walter Coke's business judgment; it does not signify any belief that the company is responsible for conditions in the communities. As EPA knows, Walter Coke strenuously contests any such claim. Below are the most recent developments relating to liability issues, and these facts obviously inform Walter Coke's consideration as to any potential entry of an AOC.

- EPA is not prepared at this time to provide any further insight into EPA's claimed liability case as to Walter Coke beyond the approximate 5-10 minute oral overview of that case by Ray Strickland in our December 16 meeting. That presentation was the first and only effort by EPA to articulate a liability case, and it was in Walter Coke's opinion incredibly general, conclusory, and uninformative.

- EPA's unwillingness to specify its claimed evidence for a liability case extends to supposed witness information EPA has stated it has obtained as to potential activities involving conveyance of fill by area industries. EPA is unreasonably (and impermissibly) electing to keep this information secret while simultaneously suggesting that Walter Coke should rely on its claimed existence as a reason to participate in the work.

- By extension, EPA's unwillingness to share its liability case means that it has not specified the extent to which that case involves events that predate the company's 1995 bankruptcy discharge, which EPA knows would be an important consideration for Walter Coke.

- EPA also continues to decline to respond to, much less rebut, information supplied by Walter Coke across the past two years demonstrating that its facility operations are not consistent with the contaminants identified in residential areas at the Site.

- EPA remains unable, despite knowing for two years that this topic was of great concern to Walter Coke, to explain anything about EPA's expectations or intentions regarding the naming of any additional PRPs. EPA likewise remains unwilling to explain any factual distinction between Walter Coke and other nearby comparable industries that would explain why the Agency has singled out Walter Coke for two years in the public eye. Walter Coke is left to conclude that EPA's enforcement discretion may be impermissibly affected by its apparent bias against Walter Coke's lawful feedstock, and to that extent at least, EPA's exercise of that discretion is arbitrary and capricious, an abuse of discretion, and contrary to law.

- During the January 16 meeting, EPA stated that it had in other instances created a joint task force of some sort to work with identified PRPs to identify additional PRPs. Walter Coke, of course, assembled an initial body of information at considerable cost on potentially relevant current and former industries in the area. The company would be interested in discussing further what such a joint task force would entail in the context of the Site, as it implies a level of sharing information by EPA that thus far has not occurred.

III. AOC comments – The proposed AOC is based on apparently flawed data.

Walter Coke has continued to review as quickly as possible large quantities of untimely-produced documents it properly requested under FOIA. And we still await requested information that is long overdue as a matter of law. Our review of the incomplete data made available suggests that EPA may be on the cusp of expending millions of taxpayer dollars in reliance on significantly flawed data its contractor collected. In particular, EPA's collected data reflects:

- An apparent failure to properly calibrate the XRF equipment (or the results from that equipment) that is the exclusive source for 90% of the arsenic and lead "results."

Such calibration of equipment and results is essential to ensure that the XRF results are reliable for decision-making purposes.

- An apparent failure to account for the well-documented interference that the presence of lead can cause in interpreting arsenic XRF results.

- Because of the above, as just one example, EPA has notified a resident that his or her property exceeds Phase 1 criteria for arsenic, where the XRF results varied by an astounding ***711 percent from*** the laboratory results that were supposed to provide quality control, and where the laboratory results showed the arsenic value in fact is below ***both*** Phase 1 and RML levels.

- Besides the specific examples that can be identified such as above, the available data set reflects serious problems generally, but we cannot fully evaluate how pervasive these problems may be as EPA has not timely fulfilled the relevant FOIA requests. For instance, approximately 90% of the samples that were submitted for lab verification reflected XRF reported values 10% (or more) higher than the more accurate lab result. About 80% of the XRF results for arsenic were overstated by 20% or more. We are still evaluating how many "false positives" these flawed results have likely produced, but the number appears significant.

- It is surprising that EPA has seemingly not identified the problems associated with its contractors' apparent misuse of XRF given that the results were so obviously inconsistent with the statistically significant number of samples previously collected and analyzed by a laboratory under an EPA-approved work plan. Walter Coke had repeatedly pointed out that arsenic levels in the communities were not a significant problem (and not a problem at all in light of EPA's revised removal action level). Simple statistical principles should have made obvious that the probability of EPA's new samples legitimately generating the results they claim to have generated was essentially zero.

- Walter Coke's preliminary analysis raises questions as well about the reliability of the XRF lead results. We have that question under continuing review. Notably and inexplicably, we still have not received the long-requested XRF results on a property-by-property basis, which is essential to fully evaluate these issues.

- These issues have the potential to result in waste of enormous sums of taxpayer dollars, and in individual cases, they have doubtlessly resulted in false alarm among residents of the communities.

- We also note that EPA stated during our meeting that its 10-4 removal action level for arsenic will be 61 ppm in light of recent scientifically-based changes to the calculation of that number. However, it appears that EPA's identification of the overall number of yards to be addressed has not been adjusted, and it appears that the relevant residents were misinformed, misleading them to believe they have an arsenic problem that does not exist, even if the underlying data were valid. Similarly, it appears that EPA has failed to adjust the applicable 10-3 figure to determine which yards should be included in Phase 1.

As presented, the AOC would not allow these issues to be properly evaluated or corrected. No company could responsibly enter an AOC on the accelerated timeline EPA demands that would obligate it to take action on such unverified, and likely flawed, data. Especially so, since EPA has often stated that any decisions would be based on sound science. For Walter Coke to agree to participate in an AOC, these issues must be subject to adequate evaluation and must either be addressed up front, or the AOC itself must expressly contain the flexibility to ensure they can be addressed in the course of performance.

IV. Comments on AOC Process.

As to the proposed AOC, Walter Coke has the following understandings from recent communications, including from our January 16 meeting:

- Of the five PRPs EPA has identified, at least three are flatly unwilling to discuss participating in an AOC.
- EPA acknowledged that its timeline for completing an AOC before EPA starts the work is unrealistic. EPA indicated that its goal was to start the work itself and then determine if private parties might take over the response under an AOC negotiated in the meantime.
- EPA indicated it would decline a redline of the AOC by Walter Coke or others showing proposed changes. EPA requests comments on the AOC, but refuses to accept comments in the form almost universally regarded as the most clear and efficient, creating some concern as to EPA's seriousness about reaching an agreement.
- EPA is unwilling to consider a cash contribution by Walter Coke to finance a portion of the Phase 1 work in exchange for a release of claims for such work.
- If it conducts the work, per its Action Memorandum, EPA plans to spend about $100,000 per property, which is approximately triple or quadruple the costs that would be incurred by private parties in similar residential cleanups. While EPA commonly attempts to persuade parties that they can perform requested work more cost-effectively than can the government, this cost estimate demonstrates indifference to performing governmental duties and spending taxpayer dollars in an appropriately cost-effective manner.

- The foregoing issue is of even greater concern in light of the above-discussed questions recently discovered by Walter Coke about the validity of data driving EPA's decision making.

- EPA acknowledges that it has not timely responded to a number of requests under the Freedom of Information Act for information that would inform the company's evaluation of EPA's request that Walter Coke enter an AOC.

Walter Coke remains prepared to work with EPA toward a private assumption of the work by a PRP group containing a critical mass of parties. The above legitimate concerns should be addressed in ongoing dialogue on that subject.

V. Other General AOC Comments.

Walter Coke would gladly meet with EPA to further discuss the issues outline above. Given Walter Coke's continued willingness to participate in the context of a meaningful critical mass of PRPs and resolution of the noted data issues, we believe more detailed AOC comments would be most constructive after any such discussion and, hopefully, resolution of the above issues.

That said, one provision of the draft AOC warrants particular mention. As was indicated in our meeting, paragraph 106 of the existing draft AOC would be entirely unacceptable, particularly in the context of an AOC for a phase of the work.

If you have any questions about the above or would like to discuss, please give me a call.

Sincerely,

Robert D. Mowrey

cc: Dan Grucza, Esq. (Walter)

Exhibit D

KAZMAREK MOWREY CLOUD LASETER LLP
ENVIRONMENTAL & ENERGY LAW

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February 26, 2014

Via Email

Marianne Lodin, Esq.
U.S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, GA 30303

Re: 35th Avenue Superfund Site

Dear Marianne,

I have received your February 7, 2014 letter response to Walter Coke's January 31 comment letter on EPA's proposed AOC for the "Phase 1" cleanup of 52 properties at the above-referenced site.

Walter Coke's comments included observations about the significant apparent flaws in the data on which the Agency is relying to make cleanup decisions and to inform, inaccurately in many instances, the public. Your February 7 letter refers to and encloses a February 12, 2013 EPA Technical Services Section (TSS) Memorandum on XRF use at the 35th Avenue Site in an apparent effort to rebut the observations Walter Coke has made. That TSS Memorandum, however, does not address the core issues raised by Walter Coke, and our review of it has revealed even deeper problems with the data than we previously recognized.

Walter Coke commented on the underlying data issues because they are foundational to any AOC negotiation. For this reason and for others, Walter Coke disagrees with EPA's characterizations of my January 31 letter. This letter is focused on the data issues, as we want to be constructive by offering EPA every opportunity to fully understand the problems Walter Coke has observed with the EPA data provided to date. To the extent the Agency plans to proceed in reliance on that data, Walter Coke also wants to set the record straight in light of the unsatisfactory and cursory treatment given those issues in the February 7 letter.

I. The TTS Memorandum does not address the core issue raised by Walter Coke.[1]

The TSS Memorandum outlines conclusions about the value of 35th Avenue Site XRF metals results as of February 2013. It did not, however, address or purport to address the complete lack of correlation between observed lab results for arsenic as compared to the recorded XRF results, since the results at issue had not yet been generated. By our calculation, the correlation coefficient is so poor (an r value = 0.21), that EPA has now announced results to community members for arsenic that are little better than results that would be obtained from a random number generator.

II. EPA apparently ignored the TSS's recommendations.

EPA's February 7 letter asserts that EPA implemented TSS's recommendations, thereby implying that Walter Coke's criticisms of EPA's lead and arsenic XRF data are misplaced because EPA has lab data justifying its decision-making. *Had* EPA had implemented the TSS recommendations, that *could* be relevant to Walter Coke's critique of EPA's data. But all information available to Walter Coke indicates that EPA did *not* implement TSS's recommendations.

TSS focused primarily on lead and concluded that lead XRF results were inadequate for cleanup decisions and recommended that all samples for which the XRF lead result was between 200 and 600 mg/kg (50% to 150% of the 400 mg/kg RML) be sent for lab analysis. By comparison, TSS's treatment of arsenic appears superficial; nevertheless, TSS also concluded that the arsenic data was unreliable and recommended that every sample with an arsenic XRF result above 40 mg/kg and a lead XRF result below 600 mg/kg be sent for lab analysis. The TSS-recommended lab submissions would have been in addition to the 10% of samples randomly selected for lab analysis under the sampling methodology.

The first clue that the TSS recommendations were not followed is that, otherwise, there would be more than 630 *additional* lab results in the record. Recognizing that, Walter Coke examined the data EPA has provided, and has readily identified at least 522 samples with XRF lead results between 200 and 600 mg/kg that apparently were *not* sent to the lab for analysis. Likewise, the data shows at least 107 samples with XRF arsenic results above 40 mg/kg and XRF lead results below 600 mg/kg that were apparently not sent for lab analysis. What EPA did was send a total of 290 samples for laboratory metals analysis, or 9.7% of the 2,976 total samples analyzed by XRF. Thus, EPA appears to have implemented *only* the sampling methodology's requirement that 10% of samples be lab-analyzed

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[1] Walter Coke was surprised to receive the TSS Memorandum with your February 7 letter, since it was clearly responsive to months-old FOIA requests. Walter Coke still has not obtained complete FOIA responses from EPA, making it difficult to completely assess the data issues and by extension the AOC.

Hence, the TSS Memorandum not only fails to address the issues raised by Walter Coke about the apparent data flaws, it further supports Walter Coke's point that EPA should have been aware long ago that its XRF data was collected in a manner unsuitable for making cleanup decisions.

III. EPA has misinformed residents about their property's condition.

Your letter disputes that EPA has misled residents based on inaccurate XRF readings. But Walter Coke's ongoing evaluation of EPA data confirms that EPA has reported erroneous lead and arsenic conditions to many residents, leading many to believe their property needs to be cleaned up when it does not. Further, the Agency appears poised, be it in Phase 1 or thereafter, to expend significant resources cleaning up on the basis of "false positive" results.

In addition to ignoring TSS's warning that the XRF data was unreliable for decision-making and that more samples should be sent to the lab, EPA ignored its own guidance for determining when XRF data is reliable for decision-making. Moreover, EPA disregarded the basic tenet that lab data should be relied on over XRF data where it is available because lab data is more accurate.[2] Instead, EPA used whichever result was higher when communicating results to residents and making decisions about cleanup, even where lab results show values below EPA-chosen thresholds. This cherry-picking of data undermines the integrity of EPA's investigations.

For example, EPA's arsenic XRF data is shockingly unreliable. The EPA data reflects 152 samples for which there is both an XRF and lab result for arsenic. The calculated correlation coefficient for this data results in an r value of 0.21, and the extent of variation ranges up to a stunning 1,824%. In other words, EPA's arsenic XRF data is essentially random, and it cannot be legitimately used for *any* purpose, much less to form the basis for a cleanup decision.

Worse, the 152 samples for which EPA has both XRF and lab arsenic data confirms that approximately nearly four-fifths of all resident notifications of arsenic above RMLs were likely erroneous. Of those 152, 77 had an XRF arsenic result above the then-applicable RML of 39 mg/kg, but 61 of those 77 (79%) had an arsenic lab result below the RML. Nevertheless, EPA reported the XRF results to the residents and led them to believe they have an arsenic problem when they do not. This problem is obviously compounded by EPA's use of a now out-of-date RML for arsenic in reports to the community. And, because 79% of the notifications where lab data actually existed erroneously stated values above RMLs, we would expect a similar error rate in the XRF-only data. Hence, the Agency

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[2] *See* EPA SESDPROC-107-R2 "*Field X-Ray Fluorescence Measurement Operating Procedure*" and EPA Method 6200 "*Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*"

appears on the verge of expending significant resources, whether in Phase 1 or in a future phase, on the basis of "false positive" results.

EPA lead results also contain problems. Of the 52 properties EPA has slated for Phase 1 removal, 36 are included because of purported lead concentrations. Of those, at least 7 have both XRF and lab results, and in all 7 instances, the lab lead result was lower than the XRF result, but EPA nevertheless reported the XRF result to the resident. And in one case, the lab result was less than half the XRF result and showed that the property does not satisfy the Phase 1 criteria. Extrapolating suggests that a number of additional properties were incorrectly determined to require Phase 1 work due to lead (and perhaps incorrectly identified as having a lead problem at all).

These problems are even more significant at properties with results above the EPA RMLs but below the EPA Phase 1 thresholds. There, 45 samples exist for which there is XRF and lab lead data and the XRF result is above the 400 mg/kg RML. Of those 45, the corresponding lab results showed that 21 actually had lead concentrations below the RML, ranging from 120 to 390 mg/kg. This subset of samples suggests that the lead XRF results have a false positive rate approaching 50%. Again, extrapolating, had EPA followed the TSS recommendations, approximately 118 additional yards reported as exceeding the lead RML would likely fall below those levels using actual lab data. Nevertheless, EPA used the XRF data and misinformed a significant number of residents of a lead problem that does not exist on their property.

Of course, because EPA is focused on lead, arsenic, and PAHs as the three COCs at the 35th Avenue Site, it is theoretically possible—despite relying on data fraught with all of the above-described flaws and misinforming many residents about the concentration on their property of one or more COCs—that EPA did not misinform every affected resident on whether their property should be cleaned up. But Walter Coke has confirmed that EPA has misinformed significant numbers of residents on that ultimate question. If EPA would like us to meet to go over those finding in more detail, we are glad to do so.

Walter Coke continues to evaluate EPA's PAH data, but the obvious problems with EPA's handling of metals data creates serious concerns about the validity of EPA's PAH evaluations.

IV. EPA has hamstrung Walter Coke by unlawfully withholding FOIA-requested documents.

Because EPA has asked Walter Coke to perform work at the 35th Avenue Site based on EPA's technical work, Walter Coke needs to be able to assess that technical work. EPA of course is not barred from freely providing this information to parties it asks to participate in removal activities, but EPA has insisted that Walter Coke go through FOIA. Walter Coke submitted an October 18, 2013 FOIA request to EPA Region 4 for documents and information that would enable Walter Coke to evaluate EPA's technical work. Most significantly, Walter Coke requested (i) full copies of documents, reports, data, and/or data compilations reflecting, generated as a result of, or relating to XRF or laboratory analysis of samples taken of any media at or in connection with the Site; and (ii) copies of all documents or things that described the policies and procedures for obtaining and analyzing samples of any media at or in connection with the Site.

EPA did not timely respond to that request, nor did it respond timely a number of prior FOIA requests and one FOIA appeal relating to Walter Coke and/or the 35th Avenue Site. The Agency finally made partial productions on December 10 and January 8, but critical documents remain outstanding. The most glaring problem is that EPA continues to withhold its logs and calibration records of XRF sample results, *which are the cornerstone of its decision-making for a significant number of the properties.* And EPA has not been otherwise transparent as to the volume or types of documents remaining for production or any timeline for their production.

Full FOIA compliance would be a critical prerequisite for any future discussion about the potential to participate in work performance. Our belated receipt of the TSS Memorandum highlights that point, as it evaluates critical weaknesses in EPA's data and prescribes corrective measures, all of which would necessarily be relevant to any such discussions. As the TSS Memorandum was indisputably responsive to Walter Coke's FOIA requests and was only disclosed in the mistaken belief that it supported the February 7 letter, Walter Coke has legitimate and growing concerns about the integrity of the FOIA system.

Lastly, EPA's characterization that Walter Coke's January 31 letter amounted to a refusal to conduct the work is specious. EPA has had control of every variable relevant to whether private parties could reasonably be expected to participate, including data completeness and integrity and the articulation (or here, lack of articulation) of a liability case. And EPA is well-aware of Walter Coke's longstanding requests as to other PRPs. Walter Coke reiterates its preparedness to further discuss participation as outlined in our January 31 comment letter.

We will be following up on the status of our FOIA requests in the near future as that may lead to additional technical comments. And we remain open to further discussing any of the issues raised in this or the January 31 comment letter.

Sincerely,

Robert D. Mowrey

cc: Dan Grucza, Esq. (Walter)

Exhibit E

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

March 20, 2014

MEMORANDUM

SUBJECT: Response to Request for TSS Review of 35th Ave Actions
35th Avenue Superfund Site, Birmingham, Alabama

FROM: Glenn Adams, Chief
Technical Services Section
Superfund Support Branch

TO: Greg Harper, On-Scene Coordinator
Richard Jardine, On-Scene Coordinator
Emergency Response and Removal Branch

In response to your e-mail of March 14, 2014, the Technical Services Section (TSS) has tried to answer the questions you provided. We reviewed the results of lead and arsenic data comparing laboratory data to field X-ray fluorescence (XRF) data and have commented on the decisions below based on the site data.

BACKGROUND

At the start of the 35th Avenue Superfund Site (Site) soil investigation in November 2012, the sampling and analysis protocol being followed at the Site was to take XRF readings of all samples, then sieve the sample and take another XRF reading, and then send 10% of all samples to a laboratory for analysis. In February of 2013, TSS was asked to review the available data to help determine if sieving and laboratory analysis was still needed. On February 13, 2013, TSS provided On-Scene Coordinator (OSC) Jeffrey Crowley a memorandum with the following recommendations:

1. TSS recommends that any samples with XRF readings of lead between 200 mg/Kg and 600 mg/Kg should be sieved and sent to the lab for metals analysis. For arsenic, any XRF readings above 40 mg/Kg should be sieved and sent to the lab for metals analysis. The exception for arsenic can be when you have XRF lead data above 600 mg/Kg in the same sample, no further arsenic data typically would be needed because of the high lead concentrations which would drive the cleanup already.

2. TSS recommends that lead concentrations in un-sieved samples greater than 600 mg/Kg and less than 200 mg/Kg can be used without needing to be sieved or sent to the lab.

3. TSS recommends that un-sieved samples with arsenic concentrations less than 40 mg/Kg can be used without needing to be sieved or sent to the lab.

During the summer of 2013, the initial investigation of the residential soils was completed with surface soil samples taken at approximately 1100 properties. The data was screened against the December 2012 Removal Management Levels (RMLs) and the data was divided into two (2) groups. One was with detections above RMLs and the other with detections below RMLs.

Responses to OSC Questions

1. **OSCs use Removal Management Levels (RMLs) as one of many tools for making a removal action decision at site, can you discuss the background of the RML and how they are used as a tools for determining a removal action?**

The Regional RMLs[1] are chemical specific concentrations for individual contaminants thay may be used to support the decision for EPA to undertake a removal action under CERCLA. RMLs help identify areas, contaminants, and conditions where a removal action may be appropriate. Sites where contaminant concentrations fall below RMLs are not necessarily "clean," and further action or study may be warranted under the Federal Superfund program. In addition, sites with contaminant concentrations above the RMLs may not necessarily warrant a removal action dependent upon such factors as background concentrations, the use of site-specific exposure scenarios, or other program considerations. While the purpose of RMLs is to help define areas, contaminants, and conditions that may warrant a removal action at a site, they do not cover every conceivable situation which EPA might need to address. On a case-specific basis, EPA may need to take action because of combinations of chemicals, chemical-specific factors, unusual site-specific circumstances, the finding of a public health hazard by the Agency for Toxic Substances and Disease Registry (ATSDR), ecological risk, or other case-specific considerations.

2. **EPA has provided sample results to property owners in a letter. The letter compares soil sample results to the December 2012 RML values, can you discuss why the EPA RML for arsenic was updated and when the new arsenic RML was published?**

EPA initiated the soil investigation work at the Site in November 2012. At that time, the RML for arsenic in residential soils was 39 mg/Kg. On December 31, 2012, an Office of Solid Waste and Emergency Response Directive (9200.1-113)[2] was signed that changed the default value for the relative bioavailability (RBA) of arsenic in soils. This Directive resulted in the arsenic RML value of 39 mg/Kg increasing to the current RML value of 61 mg/Kg. The new RML value for arsenic was not made public until August 2013.

3. **OSCs routinely use the XRF results and/or laboratory data to make removal action decisions, is a XRF result acceptable to use for removal action decisions when laboratory data is available?**

EPA uses XRF equipment in the field for many reasons. TSS has always accepted XRF data as valid for risk assessment purposes as long as there is some comparison of the field data with lab data. EPA Region 4's Science and Ecosystem Support Division (SESD) has an operating procedure (SESDPROC-107-R2)[3] available that provides guidance to field personnel on the use of XRF equipment. In February 2013, TSS reviewed the XRF and laboratory data collected to evaluate the continued use of the XRF at the Site. Please see the TSS recommendations provided in the Background section of this memorandum. TSS continues to support the use of the XRF in the field at the Site and for decision making purposes. TSS recommends using the higher of the laboratory data or the XRF data to be the most protective of human health and the environment. It should be noted that in TSS's February 2013 review of paired lead data between 200 mg/Kg and 600 mg/Kg, that the laboratory data was higher than the XRF data the majority of the time. The XRF result was above 400 mg/Kg when the laboratory concentration was below 400 mg/Kg in only a single instance.

4. **EPA's mission is to protect human health and the environment, can you explain why EPA uses the higher of the two results (XRF result or laboratory data) when making a removal action decision? Would it be considered a "false positive" when the XRF result is greater than the laboratory result?**

When TSS is evaluating XRF data versus laboratory data, it is understood there is a degree of uncertainty associated with both data sets due to the inherent heterogeneity of soil samples. TSS typically recommends using the higher value to make the risk management decision unless there is a site-specific reason not to or if there is evidence of rejected data based on quality assurance/quality control issues. TSS's review of the February 2013 sampling data for the Site and our recent additional review do not indicate any rejected data. We continue to recommend using the XRF data when it is higher than the laboratory data, and we recommend using the laboratory data when it is higher than the XRF data. The rationale for using the higher value is that it is the most protective of human health and the environment and allows for normal variability that can typically be seen between soil samples. TSS's recommendation to get laboratory data when the XRF reading for lead is between 200 and 600 mg/Kg and when arsenic data is above 40 mg/Kg reflects that point. When XRF data is higher or lower than laboratory data, it is not considered a false positive nor a false negative. There is uncertainty associated with any field data and different results between XRF and laboratory data as well as between duplicates are expected.

5. **If the arsenic data set of XRF results are compared to the corresponding laboratory data and "an r value of 0.21" results, does this mean "it cannot be legitimately used for any purpose"?**

TSS has reviewed 300+ sets of paired arsenic data (i.e., laboratory and XRF data available for the same sample) and has noted that the correlation ("Pearson's r") is low. Based on our calculations, the correlation of the unsieved data is 0.27, and the correlation of the sieved data is 0.59 for the paired arsenic data at the Site. This fact alone does not make the arsenic data unusable. The correlation statistic is a measurement of how closely the two methods would arrive at the same number for the arsenic concentration. In the case of a time-critical removal action, EPA is primarily interested in determining whether the two methods would arrive at the same decision of whether or not to take a removal action.

In the data evaluations conducted by TSS, the arsenic data shows that EPA would arrive at the same removal action decision at the arsenic sample locations in almost all cases. For example, in the evaluation of the unsieved paired arsenic data (334 samples), TSS looked at XRF data that were at or above 61 mg/Kg and had laboratory data below 61 mg/Kg and only found 4% (14 out of the 334 samples) of the data that met that criteria. Also, only 2 of that subset of samples had lead detections below 400 mg/Kg. Even though there was low correlation between XRF and lab arsenic sample concentration values, only 2 samples out of 334 samples had an XRF arsenic reading above 61 mg/Kg with a laboratory concentration below 61 mg/Kg and a lead result below 400 mg/Kg. As a result, the same removal action decision would have been made 99.4% of the time(or otherwise stated, a different decision would have been made only 0.6% of the time).

The results were similar evaluating the sieved soil data, which included 316 paired arsenic results. There were 11 XRF results that were greater than or equal to 61 mg/Kg that were in disagreement with laboratory results (i.e., laboratory data was less than 61 mg/Kg). Of this subset of data, zero (0) samples also had lead concentrations less than 400 mg/Kg. Therefore, arsenic XRF data would not have resulted in taking an action that was not confirmed by arsenic laboratory data or was not co-located with a sample with elevated lead concentrations in any instances.

Given our evaluation of the XRF data collected to date, XRF data is useful to this investigation and decision making process, and it does not appear to result in spurious removal action decisions.

6. **TSS used statistical analysis to prepare the February 2013 TSS Memorandum, can you discuss the statistical analysis behind the TSS document and why TSS recommendation is to analyze samples in the laboratory when lead between 200-600 mg/kg and arsenic over 40 mg/kg except when lead is over 600 mg/kg?**

The February 2013 TSS memorandum provided for the Site should be consulted for the specifics of the technical and statistical analysis that TSS conducted at that time. Statistical analyses performed included basic statistical and graphical comparisons of the data sets. The decision to establish the laboratory analysis recommendation for XRF lead analyses between 200-600 mg/Kg was based on the simple observation that the absolute difference between the XRF and laboratory results did not exceed 200 mg/Kg in any of the sample pairs. It was recommended that results within +/- 200 mg/Kg of the 400 mg/Kg RML for lead should be analyzed by the laboratory. Lead results less than 200 mg/Kg and greater than 600 mg/Kg could be accepted with a reasonable level of certainty that the laboratory data would indicate the same decision for action or no action. The recommendation for laboratory analyses for XRF arsenic results greater than 40 mg/Kg was a discretionary recommendation based on a comparison of the paired arsenic results at that time. Subsequent analyses have supported these recommendations as being an effective basis for time-critical removal action decisions at the Site.

TSS stated that more consideration should be given to the raw data than just statistical analyses alone, therefore additional recommendations were provided in the February 2013 memorandum (see the Background section of this memorandum). It is TSS's opinion that if these recommendations are followed, appropriate scientific decisions can be made from the available data. TSS fully understands that there will always be uncertainty associated with any data, but these TSS recommendations would decrease such uncertainty.

7. **Considering the data set from the 35th Ave Site and the current 35th Ave Action Memorandum which prioritized a subset of properties that have soil concentrations of lead greater than 1,200 mg/Kg, arsenic greater than 390 mg/Kg, and/or benzo(a)pyrene greater than 15 mg/Kg is EPA's decision to conduct a time-critical removal action on the subset of properties under proposed in the 35th Ave Action Memorandum appropriate?**

TSS typically uses the RMLs to aid in determining if a soil removal action based on direct contact with the soils is recommended. In the case of this Site, approximately 400 properties had exceedances of the residential soil RMLs. At the time the action memorandum was being developed, TSS was consulted by OSC Rick Jardine and OSC Greg Harper as to how to prioritize the response among the approximately 400 properties. TSS provided a memorandum dated September 3, 2013, titled *35th Avenue Site Surface Soil Data Consult* which supported the OSCs' chosen removal action to minimize or eliminate the potential risks to residents that may be exposed to these higher concentrations. TSS did not state that further removal actions are not warranted, but TSS agreed that the properties with the highest concentrations where exposure may be occurring should be the highest priority for a removal action.

Please let me know if you have any additional questions or if there is anything additional you need. TSS can be available for a meeting or a conference call to discuss this information at your convenience. You can reach me at 404-562-8771 if you have any additional questions.

Attachment

References

1. http://www.epa.gov/region04/superfund/programs/riskassess/rml/rml.html

2. http://www.epa.gov/superfund/bioavailability/pdfs/Transmittal%20Memo%20from%20Becki%20Clark%20to%20the%20Regions%2012-31-12.pdf

3. http://www.epa.gov/region4/sesd/fbqstp/Field-XRF-Measurement.pdf