Residential Sampling Report

Walter Coke, Inc.

Walter Coke, Inc.
Birmingham, Alabama

CH2MHILL

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Acronyms and Abbreviations

ADEM	Alabama Department of Environmental Management
BaP	benzo(a)pyrene
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
DQE	data quality evaluation
ECLR	excess lifetime cancer risk
EI	Environmental Indicator
EPA	U.S. Environmental Protection Agency
HI	hazard index
m/s	meters per second
mg/kg	milligrams per kilogram
mph	miles per hour
oz	ounce
QA/QC	quality assurance/quality control
RPD	relative percent difference

SECTION 1

Project History

1.1 Introduction

This report documents the field activities and presents the results of the investigation performed in three residential neighborhoods–Collegeville, Fairmont, and Harriman Park–located near the Walter Coke Inc., Birmingham, Alabama, facility. The work was performed in accordance with the U.S. Environmental Protection Agency (EPA) approved *Residential Sampling Work Plan*, final revision August 2008 (CH2M HILL, 2008). The work was performed in cooperation with EPA to assess whether the EPA Region 4 cumulative property action level ($1x10^{-4}$ excess lifetime cancer risk [ELCR] or non-cancer hazard index [HI] of 1) for arsenic and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) is exceeded in surface soil at residential properties in the three neighborhoods of interest. As documented in electronic mail correspondence with EPA during the planning process in 2008, Walter Coke's agreement to conduct sampling of the residential properties is not an indication that Walter Coke (formerly Sloss Industries) is responsible (solely or in part) for concentrations detected on the neighboring properties. Indeed, as indicated in Section 4 of this report, based on the evaluations discussed, there is no clear indication that the effects measured in the neighborhoods are attributable to historic or current operations of the Walter Coke facility.

1.2 Site Information

The three neighborhoods (Collegeville, Fairmont, and Harriman Park) are located in north Birmingham, Jefferson County, Alabama (Figure 1-1). The neighborhoods, which were constructed after 1957, are located in an area that has a long history of heavy multiple industrial use, as well as open pit mining. Likewise, the City of Birmingham is known for its industrial history, as documented in the Birmingham Public Library Department of Archives and Manuscripts; the archives can be accessed at http://www.birminghamarchives.org/IndustrialHistory1.htm.

1.3 Purpose and Scope

The overall purpose of this project was to voluntarily assist EPA with its gathering of data and its evaluation of concentrations of the following chemicals of potential concern (COPCs) in surface soils in the three residential neighborhoods of interest:

- Arsenic
- Benzo(a)anthracene
- Benzo(a)pyrene (BaP)
- Benzo(b)fluoranthene
- Dibenzo(a,h)anthracene
- Benzo(k)fluoranthene
- Chrysene
- Indeno(1,2,3-cd)pyrene

Specifically, EPA requested that Walter Coke investigate whether concentrations of the COPCs in surface soils exceed the cumulative property action level at four general types of properties:

1. On certain properties sampled during the Environmental Indicator (EI) evaluation (April 2005)
2. At residential yards immediately adjacent to the properties sampled during the EI evaluation with rapid screening data exceeding the preliminary chemical-specific action levels identified by EPA in 2008
3. At additional properties (not sampled during the EI evaluation) but within, and representative of, the neighborhoods
4. On school grounds in the three neighborhoods

Seventy-eight properties including residences, school properties, Harriman Park, and playgrounds were sampled. Twenty-seven of the 78 locations represent those properties previously sampled during the EI evaluation. Eight of the locations were added in the field at EPA's request and were not included in the approved *Residential Sampling Work Plan* sampling. The rationale for property selection is described in detail in the *Residential Sampling Work Plan* (CH2M HILL, 2008). Figures 1-2 through 1-4 show the sampled properties in the Collegeville, Harriman Park, and Fairmont neighborhoods, respectively.

1.4 Community Involvement

Walter Coke has been involved with the neighboring communities throughout its history. Both before and during the Residential Sampling activities, Walter Coke continued its community outreach, as outlined in the Community Involvement Plan prepared as part of the *Residential Sampling Work Plan*.

Walter Coke coordinated with EPA, the Alabama Department of Environmental Management (ADEM), and the Jefferson County Health Department to conduct an open house for neighborhood residents and other stakeholders. On June 26, 2009, a community picnic and barbeque sponsored by Walter Coke was held at Harriman Park. Representatives from the EPA, ADEM, Jefferson County Health Department, and Walter Coke were all available to provide information about the residential sampling plan and to answer questions posed by the residents.

As part of the community involvement effort, Walter Coke established an Information Repository at the North Birmingham Public Library, 2501 31st Ave. North, Birmingham, Alabama 35207. Walter Coke continues to maintain and update the Repository as needed to keep the public informed about the Residential Sampling.

SECTION 2

Field Activities

This section summarizes the field activities associated with the residential surface soil sampling performed in the three neighborhoods of interest. The sampling results are summarized in Section 3 of this report.

From July 13 through July 28, 2009, surface soil samples were collected from 78 properties within the 3 neighborhoods. The procedures for sample collection, preparation, chain-of-custody documentation, and shipping of the samples generally adhered to the *Field Branches Quality System and Technical Procedures* (EPA Region 4, November 2007). Sampling for arsenic was conducted using the *Superfund Lead-Contaminated Residential Sites Handbook* (EPA, 2003). Field sampling procedures included following the site-specific Health and Safety Plan, collecting survey information from property owners and/or residents, and collecting surface soil samples from sizeable yards at properties where written approval for access had been obtained.

2.1 Property Review

Access agreements were obtained by Walter Coke before and during the residential sampling field event. When an access agreement could not be obtained from a target property identified in the approved work plan, the location was moved to a close neighbor who would provide access.

When the field team arrived at a property, each yard was evaluated as a separate potential exposure area. The yards were measured and subsequently sampled if they had a minimum size of 10 feet in width. For larger properties, such as school yards or ball fields, the property was measured and divided into subareas of a minimum of ¼ and up to ½ acre, depending on the similar use and similar visual appearance of the property; composite samples were collected from each subarea. Field forms, which provide a rough sketch of the property and the samples collected, are located in Appendix A. Note that the property address has been removed from the copies in Appendix A for privacy reasons.

When a resident was home, a survey was performed to determine if children live at or visit the residence, if the residents plant vegetable gardens, and if the residents engage in other outdoor activities that might affect sampling location or results. When the resident was not at home during sampling, the field team completed the surveys based on observations made in the field. Resident surveys are located in Appendix A.

2.2 Sampling Procedures

The approved work plan specified the collection of samples from each individual (sizeable) yard and, where appropriate, from each vegetable garden, active children’s play area, and roof drip line (or downspout) at the target properties. Each sample type is discussed below.

2.2.1 Individual Yards

A 5-point composite soil sample was collected from each sizeable yard or subarea of larger yards (e.g., school ground) using a 5-on-dice composite pattern (Figure 2-1). To collect the discrete sub-sample points, five sample locations were selected, taking into consideration the locations of the houses within the property boundary, physical barriers, presence of potentially pressure-treated lumber, roof drip lines, and other variables. The grass (if present) was lifted at each sub-sample location and a surface soil sample was collected from the 0- to 6-inch-depth interval using a stainless-steel scoop. Sufficient soil was collected to fill two 4-ounce (oz) glass jars plus a portion of the composite sample. The soil was placed into a dedicated stainless-steel bowl and thoroughly mixed. After the sub-sample jars were filled, one scoop from each sub-sample bowl was placed into a new stainless-steel bowl for the composite sample and the soils were mixed. The composite sample jars were then filled from the composited soil. Excess soil was returned to one or more of the sub-sample holes, which were additionally filled with top soil as needed. The grass was replaced on top of the sample location.

2.2.2 Vegetable Garden and Active Children's Play Areas

When a vegetable garden or active play area was identified at a property, a grab sample was collected from the 0- to 12-inch-depth interval using a hand auger. The soil was mixed in a stainless-steel bowl and used to fill the sample jars. Two 4-oz glass jars were filled for each sample collected. Excess soil was used to refill the holes, which also were filled with top soil as needed.

2.2.3 Roof Drip Line Samples

At properties that exceeded the preliminary chemical-specific action levels during the EI sampling, an additional composite soil sample was collected from each roof drip line (or downspout, when present) from the 0- to 6-inch-depth interval. Soil from each drip line or downspout was mixed in a stainless-steel bowl and used to fill the sample jars. Two 4-oz glass jars were filled for each sample collected. Excess soil was used to refill one or more of the sample locations, which also were filled with top soil as needed.

2.2.4 Sample Summary

Table 2-1 lists, by property, the number of native samples collected by individual yard, garden and/or play area (when present), and drip line at each property.

In addition, quality assurance/quality control (QA/QC) samples were collected and/or analyzed in accordance with the approved work plan, including the following:

- Equipment rinsate blanks
- Field blanks or ambient blanks
- Laboratory method blanks
- Field duplicate samples
- Matrix spike/matrix spike duplicate samples

*T*he QA/QC samples collected at each property are identified in Table B-3, Appendix B.

2.3 Sample Location Survey and Photo Documentation

Before leaving each property, each discrete sub-sample location or grab sample location was surveyed using a Trimble Pro XRT global positioning system unit. The surveyed locations were imported into a geographic information system to develop report figures. In addition, each yard was photographed (Appendix C).

2.4 Sample Handling and Analysis

After samples were collected, they were stored either in a refrigerator or iced cooler and shipped daily to Test America Laboratories, Mobile, Alabama, for sample analysis. Each composite, garden, play area, or drip line sample was analyzed for arsenic (total) and sieved arsenic by EPA SW-846 Method 6010B, and for seven cPAHs using a low-level PAH method (EPA SW-846 Method 8270C).

SECTION 3

Data Evaluation

This section presents the approach used to evaluate the concentrations detected during the offsite sampling event conducted in July 2009 in the three neighborhoods. The composite sample data from each yard (and grab sample data from drip lines, gardens, and play areas) were evaluated. The results also are provided in this section.

3.1 Data Validation

A data quality evaluation (DQE), provided in Appendix B, was performed to assess the effect of the overall analytical process on the usability of the data. To complete the evaluation, hard-copy data packages were reviewed by the project chemist using the process outlined in the EPA guidance documents, *National Functional Guidelines for Organic Data Review* (October 1999), and the *National Functional Guidelines for Inorganic Data Review* (July 2004). A data review worksheet was completed for each of the data packages and any non-conformance was documented. The DQE concluded that the overall project objectives were met and the data can be used in the project decision-making process.

The validated analytical data (including individual cPAH concentrations) for all samples collected are presented in the DQE (Table B-2, Appendix B).

As part of the DQE, QA/QC field duplicate samples were reviewed to evaluate their appropriate use during data evaluation. Specifically, if the relative percent difference (RPD) between the duplicate and native sample result was 35 percent or greater (see Appendix B for a complete discussion), the higher of the two concentrations (native or duplicate sample) was used to calculate the risk estimate. If the RPD was less than 35 percent, the field duplicate samples served as QA/QC only.

3. 2 Comparison to EPA Target Risk Levels

In accordance with the EPA-approved work plan, the sieved and unsieved arsenic data and unsieved cPAH data were used to calculate cancer and non-cancer risk estimates at each property based on a residential exposure scenario (daily incidental ingestion, dermal contact, and inhalation exposures to surface soil for a period of 30 years). The sieved arsenic samples were collected through a 250-micron mesh sieve. The sieved samples (in relation to the unsieved) represent the portion of the soil that is more likely to adhere to hands (and be incidentally ingested) and that is more likely to become airborne (and be inhaled). When calculating risk estimates for arsenic, a conservative assumption of 100-percent bioavailability from soil was assumed, although the actual site-specific bioavailability of arsenic is a value less than 100 percent.

The cPAH data were evaluated as BaP Equivalents. The toxic equivalency factors used to calculate BaP Equivalents for each sample are provided in Table 3-1. The ELCR and non-cancer HI were estimated for sieved and unsieved arsenic data. However, only an ELCR was estimated for BaP Equivalents because of the lack of non-cancer toxicity data for cPAHs.

At the direction of EPA Region 4, the HI and cumulative ELCR for a property is represented by the maximum cumulative ELCR and HI estimated for a yard or grab sample on the property. The cumulative ELCR for each yard or grab sample was estimated using the following equation:

(Arsenic ELCR) + (BaP Equivalents ELCR) = cumulative ELCR

Subsequently, the maximum HI and cumulative ELCR for each property were compared to the EPA-identified target cumulative ELCR level of 1×10^{-4} and target HI of 1 for a residential scenario.

Table 3-2 summarizes the sieved and unsieved arsenic concentrations and calculated BaP Equivalents for soil samples (composite and grab) from each property. As noted in Table 3-2, the sieved samples contain lower arsenic concentrations than do the unsieved samples in most cases, with a few exceptions, indicating that the larger soil particles typically contain higher arsenic concentrations than the finer-grained soil.

The HI and cumulative ELCR for each property were estimated using the data presented in Table 3-2. Table 3-3 summarizes the properties with a maximum HI or cumulative ELCR that exceeds EPA target risk levels based on sieved and unsieved arsenic concentrations and calculated BaP Equivalents concentrations. The results are grouped by neighborhood to aid in the evaluation of data. In addition, the number of samples at a property that exceed EPA target risk levels in relation to the total number of samples collected at the property is presented for perspective.

In comparison to the other two neighborhoods, there are more properties in the Harriman Park neighborhood that exceeded only the target HI for unsieved arsenic compared to the total number of properties sampled and those exceeding EPA target risk levels based on sieved arsenic concentrations. Conversations with Harriman Park residents regarding historical residential activities that may explain the discrepancy between neighborhoods are discussed further in Section 3.5.2, Field Observations.

As discussed with EPA Region 4, the sieved (rather than unsieved) arsenic data represent the portion of the soil that is more pertinent for human exposure. Therefore, Figure 3-1 (Collegeville Neighborhood), Figure 3-2 (Harriman Park Neighborhood), and Figure 3-3 (Fairmont Neighborhood) are aerial photographs depicting the properties that exceed the risk-based target levels within each neighborhood based on sieved arsenic data and unsieved BaP Equivalent concentrations. The distributions of the results in the figures show no spatial pattern across each neighborhood; this aspect is discussed further in Sections 3.3 through 3.5. Properties where sampling field notes indicate a possible explanation for elevated concentrations are noted in the figure and discussed further in Section 3.5.2.

3.3 Background Considerations

Given the local geology and the long history of multiple industries and activities in the immediate area that could contribute arsenic and cPAHs to the environment, some portion of the arsenic and cPAH concentrations detected in offsite soil probably is due to background levels (residential, historical industrial, and/or naturally occurring). When relatively low target risk levels are used to calculate risk-based concentrations, background concentrations often exceed the risk-based levels. In addition, in areas where high background levels are present, as is possible in the three neighborhoods sampled, background levels can often be higher than risk-based concentrations that are based on relatively high target risk levels. As noted in EPA's *Role of Background in the CERCLA Cleanup* Program guidance (EPA, 2002), "Background information is important to risk managers because the CERCLA program, generally, does not clean up to concentrations below natural or anthropogenic background levels." The guidance also states that "COPCs with high background concentrations should be discussed in the risk characterization, and if data are available, the contribution of background to site concentrations should be distinguished." For these reasons, it is prudent to consider background concentrations of arsenic and cPAHs (presented as BaP Equivalents) in the vicinity of the sampled properties. Because the collection of background samples was not scoped as part of this field investigation, the following evaluation provides a basis for assessing potential background values of sieved arsenic and unsieved BaP Equivalents in the neighborhoods due to area-wide activities.

A normal probability plot graphs measured concentrations against theoretical quantiles assuming that the data distribution is normal (as opposed to lognormal or another distribution type). Strong inflections or "breakpoints" may serve as evidence that multiple populations appear in the dataset, which could indicate a threshold concentration separating generally dispersed levels of a chemical and unusually affected concentrations. Overall curvature in a plot (often appearing most visible in the upper tail with environmental data) tends to indicate that the data are not drawn from a normal parent population; this should not be confused with an indication of multiple populations (as a stronger inflection point might indicate).

Figure 3-4 presents probability plots for sieved arsenic and unsieved BaP Equivalents concentrations detected across the three neighborhoods. A review of these plots indicates that inflection points (noted by a fairly sudden change in the slope of the concentration data) are present in both plots. Values reported below the inflection point may represent concentrations that are typical to the area sampled (for example, the use of coal- or wood-burning stoves, runoff from roadways, or natural background levels). Values greater than the inflection point may indicate an impact that is not common to all properties sampled.

As shown in Figure 3-4, the inflection point for the BaP Equivalents' plot is 3.5 milligrams per kilogram (mg/kg); Figures 3-5 through 3-7 show the sample locations that exceeded this inflection point value in each of the neighborhoods. The inflection point presented for arsenic in Figure 3-4 is 24 mg/kg; Figures 3-8 and 3-9 show the locations that exceeded this inflection point in the Collegeville and Harriman Park neighborhoods, respectively, noting that no locations exceeded the arsenic inflection point in the Fairmont neighborhood.

3.4 Spatial Trend Analysis

On the basis of the background evaluation, concentrations less than 3.5 mg/kg and 24 mg/kg may represent anthropogenic background values of BaP Equivalents and sieved arsenic, respectively. From a review of Figures 3-5 through 3-9, no spatial trend was observed in locations that exceeded the background concentration values.

Although the spatial randomness of exceedances is difficult to compare statistically due to the lack of statistical power associated with the relatively low number of exceedances (which would be handled using discrete statistics), the overall concentrations can be more effectively compared. Any such spatial evaluation should be considered relative to potential source locations. Tukey's multiple comparison test (using a typical significance level of 0.05) was performed on the ranks of the data (where higher ranks are associated with higher concentrations; for instance, the lowest of five concentrations would have the rank of 1, while the highest would have the rank of 5). The comparison test on the ranks of data from each neighborhood provides information about the differences among the arsenic and BaP Equivalents concentrations via spatial partitions in the neighborhoods of interest. The method of analysis on the ranks of the data presents a nonparametric approach that does not require the data to resemble a known distribution (i.e., a normal distribution) and is thus similar to the Wilcoxon Rank Sum test (a standard statistical comparison technique for comparing two populations) in that regard.

A spatial partition, using grid overlays for the three neighborhoods, is depicted in Figure 3-10. The results of Tukey's test are presented in Table 3-4, with the evaluation summarized as character letters. As is traditional for multiple comparisons, all grids not statistically different from the highest concentration grids are provided a character of "A". If the concentrations in a given grid are statistically different from the highest concentration grids, that grid is provided a character of "B". Grids that are not statistically different from either "A" or "B" grids are provided a character of "AB". Statistical differences occur when the differences between grids are greater than the differences within grids.

The results in Table 3-4 indicate that no statistical differences exist between grids for arsenic in any of the three neighborhoods. For BaP Equivalents, there are only three grids in the Harriman Park neighborhood that express some statistical differences from the rest of the Harriman Park grids. These are grids A2 and B5 with "A" designations and B3 with a "B" designation. The rest of the grids have "AB" designations. One might expect a small number of false positives from this test; a review of the grid locations in Figure 3-10 and the three grids with unique "A" or "B" designations (A2, B3, and B5) shows that they do not appear to form any consistent spatial pattern. Thus, there does not appear to be evidence of a spatial gradient associated with proximity to any one source.

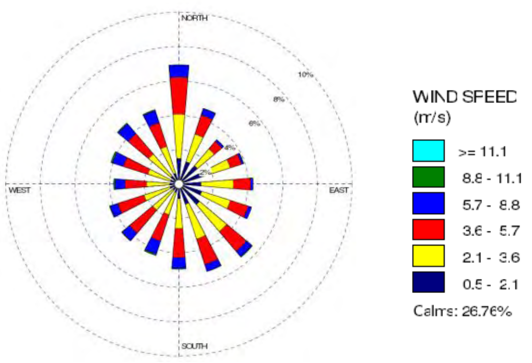
3.5 Additional Observations

As noted previously, the area around the three neighborhoods includes a mixture of industrial and open pit mining, as well as residential, uses. In addition to the coke production industries in the area, steel production and metal foundries surround the neighborhoods. To further support the evaluation of the residential soil sampling results, potential wind-born deposition of arsenic and cPAHs was investigated, in addition to consideration of other industrial and residential activities.

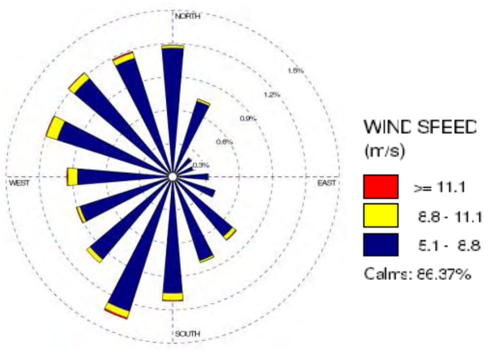
3.5.1 AERMOD Modeling

To aid in evaluating the data for potential patterns, a wind-depositional model was constructed to represent potential wind-born deposition from the onsite coal piles (per EPA's expressed interest) located in the southern tip of the Walter Coke facility. The EPA AERMOD modeling software was used to develop anticipated depositional patterns from coal-pile dust into the neighborhoods. To complete the model, a 5-year wind rose representative of recent meteorological conditions was developed for use in this modeling effort (see below). It shows winds fairly evenly distributed in all directions; however, wind speeds above a certain threshold are needed for particulates to become airborne off of a pile or surface. A wind speed threshold of 11.5 miles per hour (mph), equivalent to 5.1 meters per second (m/s), was used in the wind blown dust emission calculations; a wind rose showing wind speeds above 11.5 mph (5.1 m/s), therefore, is also shown below. The 11.5-mph wind rose indicates a different pattern with a predominance of winds from all directions except the east. As indicated, winds from the northwest to north would push particulate emissions toward the Collegeville Neighborhood under higher wind speeds.

Birmingham Wind Rose



Birmingham Wind Rose greater than 5.1 m/s



On the basis of the model results, only the Collegeville and Fairmont neighborhoods would be affected by possible wind deposition off of the coal piles; Figures 3-11 and 3-12 show the patterns for deposition, along with the depositional contours in the Collegeville and Fairmont neighborhoods, respectively. It is noted that unit emission rates were applied to the modeled source (onsite coal piles); therefore, deposition contours are used to identify patterns of deposition, rather than concentrations. The pattern for possible deposition from the large coal stockpile as an area source shows a potential higher deposition to the southwest, with a gradual drop off with distance.

Similar to the spatial partition evaluated on the grid overlays for each neighborhood (Section 3.4), a second spatial partition was applied only to the Collegeville neighborhood and the deposition bands, as shown in Figure 3-13. The results of Tukey's test applied to arsenic and BaP Equivalents concentrations within the bands are presented in Table 3-5. These results indicate that none of the bands ringing from the coal piles is statistically shifted above the others. These spatial evaluations reinforce the observation of a lack of spatial gradients associated with wind-born deposition from the coal piles.

To evaluate whether the arsenic and BaP Equivalents concentrations are likely to be originating from the same (or a single) source, a correlation evaluation of all results also was performed. Pearson and (nonparametric) Spearman correlation coefficients (based on ranks of the data) were calculated for paired arsenic-BaP Equivalents data and are reported in Table 3-6.

The correlation coefficients measure the strength of a linear relationship between two data sets; that is, how much association exists between a change in the concentration of one parameter and the concentration of another parameter. These correlation coefficients range from -1 to +1. A zero value indicates no observed correlation, whereas more negative or positive values indicate increasing correlation, either inverse (-1) or direct (+1), respectively.

Although the Pearson correlation coefficient is probably the most frequently used, outlying pairs can be very influential on the calculated coefficient (potentially either greatly increasing or decreasing the calculated value). For that reason, the Pearson value was calculated using the entire data set (Figure 3-14) and after excluding four elevated BaP Equivalents values (Figure 3-15). The Pearson coefficient also was calculated using log-transformed arsenic and BaP Equivalents data. These transformed data are presented in Figure 3-16. All Pearson correlation coefficients were quite low (values of 0.1 or less). Likewise, the Spearman coefficients were low (0.184 or less).

One approach to interpreting the Pearson and Spearman coefficients is to calculate the square of the coefficients (listed as percentages [“Approximate Variability Explained”] in Table 3-6). The calculations yield percentages of 3.4 percent or less, indicating that there is essentially no effective correlation between the concentrations of arsenic and BaP Equivalents (that is, the chemicals probably do not originate from the same source).

3.5.2 Field Observations

As discussed in Section 3.3, some portion of the arsenic and BaP Equivalents concentrations likely can be attributed to current and historical residential activity. Several field observations were made where residential activities that may have affected soil concentrations were noted. Properties with such observations that also exceeded EPA target risk levels are identified in Figures 3-1 through 3-3. Example observations that were noted both on the field forms (Appendix A) and from photographs (Appendix C) include the following:

- Cars parked in yards and cars being worked on in yards
- Backyard grills, including historical brick stationary grills and modern charcoal grills
- Yards with residential trash such as charcoal and cigarette ash, paint cans, car parts, etc.
- Pieces of asphalt roofing shingles in yards

In addition to documented observations, conversations with residents provided insight to possible historical activity that may have affected soils in the area. In particular, residents of the Harriman Park neighborhood recalled collecting coal dropped along the railroad track that runs along the eastern boundary of the neighborhood. The coal was stored in yards or houses and used as fuel to heat the residences.

SECTION 4

Conclusions

The results of the residential soil sampling indicate the presence of arsenic and cPAHs on some properties at concentrations exceeding EPA's target risk levels for a residential exposure scenario. The EPA target risk levels are protective of daily soil exposure from incidental ingestion, dermal contact, and inhalation of dust over a 30-year period. Although EPA's target risk levels were exceeded at several properties, there is no spatial pattern in the analytical data. The spatial evaluations (relative to a potential source location) are summarized below:

- Results of the grid evaluation demonstrate that no statistical difference exists between sampling grids within each neighborhood.
- Results of the spatial partition applied to the Collegeville neighborhood depositional bands reinforce the lack of spatial gradients in the data.

The results of the correlation evaluation demonstrate that the arsenic and BaP Equivalents concentrations probably originate from more than one source, as follows:

- The correlation evaluation indicates virtually no correlation of the data (correlation values of 0.1 or less).
- The squares of the correlation coefficients indicate no effective correlation between the arsenic and BaP Equivalents data.

Local industries probably have contributed to the presence of arsenic and cPAHs in the neighborhoods due to the following:

- Birmingham's rich industrial history
- Local industries in proximity to the neighborhoods

Historical and current residential activity also has contributed to the presence of arsenic and cPAHs in the neighborhoods. These include the following:

- Historic use of coal for residential heating in the neighborhoods
- Residential yards used as driveways
- Use of pesticides and/or treated lumber in yards
- Storage of household chemicals in yards

On the basis of the data and their evaluation, there is no clear indication that the arsenic and cPAHs found in the neighborhoods are attributable to historic or current operations of the Walter Coke facility.

SECTION 5

Works Cited

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Tables

TABLE 2-1

Samples Collected Per Property

Walter Coke Inc. - Birmingham, Alabama

Collegeville

Sample Location	Number of Yards	Garden	Play Area	Dripline
OSS-01	1			
OSS-02	3			
OSS-03	3			1
OSS-04[A]	4		2	
OSS-05	2			
OSS-06	2			
OSS-07	2			
OSS-08	4			
OSS-09	2	1		1
OSS-10[A]	7		1	
OSS-11	3			
OSS-12	2			
OSS-13	2			1
OSS-14	1			
OSS-15	1			
OSS-16	2		1	
OSS-17	3			
OSS-18	2	1		
OSS-19	2			
OSS-20	2			
OSS-21	2			
OSS-22	2			
OSS-23	1			
OSS-24	4	2		
OSS-25	3			
OSS-26	2			
OSS-27	2			
OSS-28	2			
OSS-29	3	1		
OSS-30	2			
OSS-31	2			
OSS-32[A]	13			
OSS-33	3			
OSS-34	3			
OSS-35	3			
OSS-36	3			
OSS-37	3			
OSS-38	1			
OSS-39	1			
OSS-40	2			
OSS-41	4	1		
TOTAL:	***111***	***6***	***4***	***3***

Harriman Park

Sample Location	Number of Yards	Garden	Play Area	Dripline
OSE-01	3			
OSE-02	2	2		
OSE-03	2			1
OSE-04	2			
OSE-05	3			
OSE-06	3			
OSE-07	2		1	
OSE-08	3			
OSE-09	3	1		
OSE-10	2			
OSE-11	1			
OSE-12[B]	6			
OSE-13	3			
OSE-14	3			
OSE-15	1			
OSE-16	3			
OSE-17	2			
OSE-18	3	2		
OSE-19	2			
OSE-20	1			
OSES-1[B]	1			
OSES-2[B]	1			
OSES-3[B]	1			
TOTAL:	***53***	***5***	***1***	***1***

Fairmont

Sample Location	Number of Yards	Garden	Play Area	Dripline
OSW-8[A]	12			4
OSW-13	2			
OSW-14	3			
OSW-15	3			
OSW-16	3			
OSW-17	5			
TOTAL:	***28***	***0***	***0***	***4***

Additional Collegeville Properties (Selected by EPA)

Sample Location	Number of Yards	Garden	Play Area	Dripline
EPA-01	2	1		
EPA-02	2	1		
EPA-03	3			
EPA-04	2	1		
EPA-05	1			
EPA-06	1			
EPA-07	2			
EPA-08	3			
TOTAL:	***16***	***3***	***0***	***0***

Notes:

A blank cell indicates a sample was not collected.

[A] = Indicates the property is an active or former school.

[B] = Sample collected within the neighborhood park, known as Harriman Park

TABLE 3-1

Toxic Equivalency Factors Used to Calculate BaP Equivalents per Sample

Walter Coke Inc. - Birmingham, Alabama

Carcinogenic PAH	Toxic Equivalency Factor
Benzo[a]pyrene	1.0
Benzo[a]anthracene	0.1
Benzo[b]fluoranthene	0.1
Benzo[k]fluoranthene	0.01
Chrysene	0.001
Dibenz(a,h)anthracene	1.0
Indeno[1,2,3-cd]pyrene	0.1

Notes:

BaP = Benzo(a)pyrene

PAH = Polycyclic aromatic hydrocarbon

TABLE 3-2
Summary of Concentrations used in the Risk Screening
Walter Coke Inc. - Birmingham, Alabama

Station ID	Property ID	Sample Yard/Location	Unseived Arsenic (mg/kg)	Seived Arsenic (mg/kg)	BaP Equivalents (mg/kg)
Collegeville					
OSS1-B-C	OSS-1	Back Yard	12	8.5	0.147
OSS2-B-C	**OSS-2**	**Back Yard**	**35**	**20**	**0.150**
OSS2-F-C	**OSS-2**	**Front Yard**	**39**	**22**	**0.197**
OSS2-L-C	**OSS-2**	**Left Yard**	**27**	**15**	**0.118**
OSS3-D	**OSS-3**	**Dripline**	**14**	**15**	**1.501**
OSS3-B-C	OSS-3	Back Yard	11	9.4	0.128
OSS3-F-C	**OSS-3**	**Front Yard**	**18**	**24**	**4.837**
OSS3-L-C	**OSS-3**	**Left Yard**	**9.7**	**12**	**3.474**
OSS4-B-C	OSS-4	Back Yard	17	17	0.335
OSS4-F-C	**OSS-4**	**Front Yard**	**24**	**12**	**0.694**
OSS4-L-C	OSS-4	Left Yard	16	17	0.539
OSS4-P1-C	OSS-4	Play Area 1	19	8	0.189
OSS4-P2-C	OSS-4	Play Area 2	20	16	0.475
OSS4-R-C	OSS-4	Right Yard	12	12	0.858
OSS5-B-C	OSS-5	Back Yard	11	7.7	0.143
OSS5-F-C	**OSS-5**	**Front Yard**	**28**	**18**	**0.440**
OSS6-B-C	OSS-6	Back Yard	21	9.7	0.448
OSS6-F-C	**OSS-6**	**Front Yard**	**23**	**13**	**0.519**
OSS7-B-C	**OSS-7**	**Back Yard**	**27**	**12**	**0.141**
OSS7-F-C	**OSS-7**	**Front Yard**	**23**	**14**	**0.452**
OSS8-B-C	OSS-8	Back Yard	20	11	0.326
OSS8-F-C	OSS-8	Front Yard	13	11	0.458
OSS8-L-C	OSS-8	Left Yard	19	18	0.423
OSS8-R-C	**OSS-8**	**Right Yard**	**15**	**16**	**0.895**
OSS9-B-C	**OSS-9**	**Back Yard**	**19**	**18**	**8.158**
OSS9-D	**OSS-9**	**Dripline**	**9.9**	**16**	**2.298**
OSS9-F-C	**OSS-9**	**Front Yard**	**19**	**19**	**1.044**
OSS9-G	**OSS-9**	**Garden**	**35**	**40**	**2.953**
OSS10-BA-C	**OSS-10**	**Sub: BA**	**26**	**17**	**0.812**
OSS10-BB-C	OSS-10	Sub: BB	21	18	0.629
OSS10-BC-C	OSS-10	Sub: BC	18	7.4	0.650
OSS10-BD-C	OSS-10	Sub: BD	15	8.3	0.926
OSS10-F-C	**OSS-10**	**Front Yard**	**24**	**15**	**39.30**
OSS10-L-C	**OSS-10**	**Left Yard**	**19**	**14**	**29.07**
OSS10-P-C	**OSS-10**	**Play Area - Composite**	**38**	**30**	**2.621**
OSS10-P-G	**OSS-10**	**Play Area - Grab**	**39**	**38**	**7.275**
OSS11-B-C	OSS-11	Back Yard	22	11	0.204
OSS11-F-C	**OSS-11**	**Front Yard**	**22**	**13**	**12.41**
OSS11-R-C	OSS-11	Right Yard	16	13	0.467
OSS12-B-C	**OSS-12**	**Back Yard**	**31**	**11**	**0.893**
OSS12-F-C	**OSS-12**	**Front Yard**	**27**	**15**	**0.291**
OSS13-B-C	**OSS-13**	**Back Yard**	**31**	**30**	**1.246**
OSS13-D	**OSS-13**	**Dripline**	**26**	**30**	**0.436**
OSS13-F-C	**OSS-13**	**Front Yard**	**37**	**38**	**1.378**
OSS14-F-C	OSS-14	Front Yard	18	20	0.380
OSS15-C	**OSS-15**		**26**	**29**	**1.729**
OSS16-B-C	OSS-16	Back Yard	13	13	0.352
OSS16-F-C	**OSS-16**	**Front Yard**	**23**	**22**	**0.545**
OSS16-P	OSS-16	Play Area	17	13	0.725
OSS17-B-C	**OSS-17**	**Back Yard**	**23**	**17**	**0.627**
OSS17-F-C	**OSS-17**	**Front Yard**	**37**	**38**	**0.968**
OSS17-L-C	**OSS-17**	**Left Yard**	**26**	**29**	**0.836**
OSS18-B-C	**OSS-18**	**Back Yard**	**40**	**18**	**0.272**
OSS18-F-C	**OSS-18**	**Front Yard**	**28**	**24**	**0.487**
OSS18-G	**OSS-18**	**Garden**	**45**	**20**	**0.309**

TABLE 3-2
Summary of Concentrations used in the Risk Screening
Walter Coke Inc. - Birmingham, Alabama

Station ID	Property ID	Sample Yard/Location	Unseived Arsenic (mg/kg)	Seived Arsenic (mg/kg)	BaP Equivalents (mg/kg)
Collegeville (cont'd)					
OSS19-B-C	OSS-19	Back Yard	17	21	0.419
OSS19-F-C	**OSS-19**	**Front Yard**	**20**	**15**	**1.725**
OSS20-F-C	OSS-20	Front Yard	16	15	0.248
OSS20-R-C	OSS-20	Right Yard	19	18	0.316
OSS21-B-C	**OSS-21**	**Back Yard**	**12**	**12**	**7.851**
OSS21-F-C	**OSS-21**	**Front Yard**	**22**	**11**	**5.862**
OSS22-B-C	OSS-22	Back Yard	18	11	0.133
OSS22-F-C	OSS-22	Front Yard	19	10	0.551
OSS23-F-C	OSS-23	Front Yard	22	19	0.144
OSS24-B-C	**OSS-24**	**Back Yard**	**17**	**13**	**2.277**
OSS24-F-C	OSS-24	Front Yard	21	14	0.337
OSS24-G1	**OSS-24**	**Garden 1**	**20**	**11**	**1.049**
OSS24-G2	**OSS-24**	**Garden 2**	**31**	**26**	**0.837**
OSS24-L-C	**OSS-24**	**Left Yard**	**20**	**15**	**0.964**
OSS24-R-C	**OSS-24**	**Right Yard**	**20**	**21**	**0.749**
OSS25-B-C	**OSS-25**	**Back Yard**	**30**	**14**	**0.240**
OSS25-F-C	**OSS-25**	**Front Yard**	**21**	**18**	**0.769**
OSS25-R-C	OSS-25	Right Yard	19	18	0.288
OSS26-B-C	OSS-26	Back Yard	22	12	0.159
OSS26-F-C	**OSS-26**	**Front Yard**	**32**	**19**	**0.290**
OSS27-B-C	**OSS-27**	**Back Yard**	**42**	**14**	**3.378**
OSS27-F-C	OSS-27	Front Yard	15	12	0.895
OSS28-B-C	OSS-28	Back Yard	7.4	6.9	0.384
OSS28-F-C	OSS-28	Front Yard	11	9	0.106
OSS29-B-C	**OSS-29**	**Back Yard**	**18**	**13**	**3.478**
OSS29-F-C	**OSS-29**	**Front Yard**	**31**	**14**	**0.428**
OSS29-G	**OSS-29**	**Garden**	**27**	**8.2**	**0.242**
OSS29-R-C	**OSS-29**	**Right Yard**	**20**	**16**	**4.083**
OSS30-B-C	**OSS-30**	**Back Yard**	**13**	**14**	**3.322**
OSS30-F-C	**OSS-30**	**Front Yard**	**19**	**16**	**10.701**
OSS31-B-C	**OSS-31**	**Back Yard**	**11**	**11**	**1.104**
OSS31-F-C	**OSS-31**	**Front Yard**	**17**	**15**	**6.013**
OSS32-BA-C	OSS-32	Sub: BA	3.4	5.6	0.075
OSS32-BB-C	**OSS-32**	**Sub: BB**	**8.3**	**15**	**1.890**
OSS32-BC-C	**OSS-32**	**Sub: BC**	**13**	**15**	**2.892**
OSS32-BD-C	**OSS-32**	**Sub: BD**	**18**	**20**	**1.705**
OSS32-BE-C	OSS-32	Sub: BE	5.8	6	0.055
OSS32-BF-C	**OSS-32**	**Sub: BF**	**10**	**16**	**1.022**
OSS32-BG-C	**OSS-32**	**Sub: BG**	**38**	**36**	**0.266**
OSS32-BH-C	**OSS-32**	**Sub: BH**	**63**	**46**	**0.216**
OSS32-BI-C	**OSS-32**	**Sub: BI**	**31**	**12**	**0.607**
OSS32-BJ-C	**OSS-32**	**Sub: BJ**	**26**	**29**	**1.052**
OSS32-BK-C	**OSS-32**	**Sub: BK**	**20**	**18**	**2.554**
OSS32-BL-C	**OSS-32**	**Sub: BL**	**16**	**14**	**2.039**
OSS32-F-C	**OSS-32**	**Front Yard**	**15**	**14**	**6.992**
OSS33-B-C	**OSS-33**	**Back Yard**	**22**	**10**	**13.674**
OSS33-F-C	**OSS-33**	**Front Yard**	**12**	**13**	**1.043**
OSS33-L-C	**OSS-33**	**Left Yard**	**13**	**14**	**16.03**
OSS34-B-C	OSS-34	Back Yard	21	12	1.033
OSS34-F-C	**OSS-34**	**Front Yard**	**12**	**11**	**2.362**
OSS34-R-C	OSS-34	Right Yard	8.7	10	0.215
OSS35-B-C	OSS-35	Back Yard	17	19	0.357
OSS35-F-C	**OSS-35**	**Front Yard**	**12**	**18**	**2.598**
OSS35-R-C	OSS-35	Right Yard	21	17	0.453

TABLE 3-2
Summary of Concentrations used in the Risk Screening
Walter Coke Inc. - Birmingham, Alabama

Station ID	Property ID	Sample Yard/Location	Unseived Arsenic (mg/kg)	Seived Arsenic (mg/kg)	BaP Equivalents (mg/kg)
Collegeville (cont'd)					
OSS36-F-C	**OSS-36**	**Front Yard**	**19**	**10**	**2.002**
OSS36-L-C	OSS-36	Left Yard	15	8.6	0.337
OSS36-R-C	**OSS-36**	**Right Yard**	**25**	**10**	**0.435**
OSS37-B-C	OSS-37	Back Yard	14	8.7	0.942
OSS37-F-C	OSS-37	Front Yard	14	13	0.554
OSS37-L-C	OSS-37	Left Yard	14	10	0.928
OSS38-F-C	**OSS-38**	**Front Yard**	**32**	**20**	**0.358**
OSS39-F-C	OSS-39	Front Yard	19	16	0.212
OSS40-B-C	OSS-40	Back Yard	18	10	0.221
OSS40-F-C	OSS-40	Front Yard	18	15	0.171
OSS41-B-C	OSS-41	Back Yard	20	19	0.256
OSS41-F-C	**OSS-41**	**Front Yard**	**20**	**23**	**0.686**
OSS41-G	**OSS-41**	**Garden**	**23**	**18**	**1.124**
OSS41-L-C	OSS-41	Left Yard	21	21	0.364
OSS41-R-C	**OSS-41**	**Right Yard**	**20**	**21**	**1.201**
EPA1-B-C	EPA-1	Back Yard	9.5	10	0.452
EPA1-F-C	**EPA-1**	**Front Yard**	**34**	**9.9**	**15.2**
EPA1-G	EPA-1	Garden	13	7.4	0.169
EPA2-B-C	EPA-2	Back Yard	20	13	0.318
EPA2-F-C	EPA-2	Front Yard	18	14	0.329
EPA2-G	**EPA-2**	**Garden**	**6**	**6.4**	**12.842**
EPA3-B-C	**EPA-3**	**Back Yard**	**27**	**18**	**14.802**
EPA3-F-C	EPA-3	Front Yard	12	12	0.487
EPA3-L-C	**EPA-3**	**Left Yard**	**26**	**18**	**0.662**
EPA4-B-C	EPA-4	Back Yard	17	3.7	0.233
EPA4-F-C	EPA-4	Front Yard	21	22	0.221
EPA4-G	EPA-4	Garden	17	7.1	0.112
EPA5-L-C	**EPA-5**	**Left Yard**	**24**	**16**	**0.413**
EPA6-B-C	**EPA-6**	**Back Yard**	**32**	**26**	**0.784**
EPA7-B-C	EPA-7	Back Yard	13	11	0.223
EPA7-F-C	EPA-7	Front Yard	20	16	0.644
EPA8-B-C	**EPA-8**	**Back Yard**	**27**	**23**	**1.107**
EPA8-F-C	**EPA-8**	**Front Yard**	**23**	**20**	**1.306**
EPA8-R-C	EPA-8	Right Yard	20	13	0.533
Harriman Park					
OSE1-B-C	OSE-1	Back Yard	17	12	0.487
OSE1-F-C	**OSE-1**	**Front Yard**	**19**	**22**	**8.486**
OSE1-L-C	**OSE-1**	**Left Yard**	**68**	**7.6**	**0.655**
OSE2-B-C	**OSE-2**	**Back Yard**	**28**	**20**	**0.972**
OSE2-F-C	OSE-2	Front Yard	15	12	0.555
OSE2-G1	OSE-2	Garden 1	18	11	0.267
OSE2-G2	OSE-2	Garden 2	13	13	0.153
OSE3-B-C	OSE-3	Back Yard	15	15	0.792
OSE3-D	**OSE-3**	**Dripline**	**39**	**20**	**3.887**
OSE3-F-C	**OSE-3**	**Front Yard**	**31**	**16**	**0.421**
OSE4-B-C	OSE-4	Back Yard	20	15	0.253
OSE4-F-C	**OSE-4**	**Front Yard**	**28**	**24**	**1.119**
OSE5-B-C	**OSE-5**	**Back Yard**	**26**	**13**	**0.270**
OSE5-F-C	OSE-5	Front Yard	16	9.7	0.184
OSE5-L-C	**OSE-5**	**Left Yard**	**23**	**15**	**0.244**
OSE6-B-C	**OSE-6**	**Back Yard**	**27**	**19**	**3.422**
OSE6-L-C	**OSE-6**	**Left Yard**	**26**	**13**	**8.498**
OSE6-R-C	OSE-6	Right Yard	21	8.8	0.386
OSE7-F-C	**OSE-7**	**Front Yard**	**27**	**15**	**1.061**
OSE7-P	**OSE-7**	**Play Area**	**43**	**21**	**0.198**
OSE7-R-C	OSE-7	Right Yard	19	9.8	0.262
OSE8-B-C	**OSE-8**	**Back Yard**	**49**	**13**	**0.173**
OSE8-F-C	**OSE-8**	**Front Yard**	**26**	**20**	**0.219**

TABLE 3-2
Summary of Concentrations used in the Risk Screening
Walter Coke Inc. - Birmingham, Alabama

Station ID	Property ID	Sample Yard/Location	Unseived Arsenic (mg/kg)	Seived Arsenic (mg/kg)	BaP Equivalents (mg/kg)
Harriman Park (cont'd)					
OSE8-L-C	**OSE-8**	**Left Yard**	**30**	**16**	**0.217**
OSE9-B-C	**OSE-9**	**Back Yard**	**29**	**18**	**0.418**
OSE9-F-C	**OSE-9**	**Front Yard**	**29**	**15**	**0.250**
OSE9-G	**OSE-9**	**Garden**	**27**	**14**	**1.645**
OSE9-L-C	OSE-9	Left Yard	22	17	0.522
OSE10-B-C	OSE-10	Back Yard	16	8.9	0.644
OSE10-F-C	OSE-10	Front Yard	14	9	0.275
OSE11-F-C	**OSE-11**	**Front Yard**	**19**	**22**	**1.143**
OSE12-AA-C	**OSE-12**	**Sub: AA**	**23**	**19**	**0.164**
OSE12-BB-C	**OSE-12**	**Sub: BB**	**25**	**21**	**0.315**
OSE12-CC-C	**OSE-12**	**Sub: CC**	**32**	**17**	**0.159**
OSE12-DD-C	**OSE-12**	**Sub: DD**	**25**	**20**	**0.122**
OSE12-EE-C	OSE-12	Sub: EE	18	16	0.199
OSE12-FF-C	**OSE-12**	**Sub: FF**	**25**	**16**	**0.131**
OSE13-B-C	**OSE-13**	**Back Yard**	**25**	**13**	**0.164**
OSE13-F-C	**OSE-13**	**Front Yard**	**25**	**20**	**0.408**
OSE13-R-C	OSE-13	Right Yard	19	12	0.244
OSE14-B-C	**OSE-14**	**Back Yard**	**27**	**13**	**0.132**
OSE14-F-C	**OSE-14**	**Front Yard**	**33**	**16**	**0.247**
OSE14-R-C	**OSE-14**	**Right Yard**	**32**	**21**	**0.160**
OSE15-F-C	**OSE-15**	**Front Yard**	**42**	**18**	**0.160**
OSE16-B-C	**OSE-16**	**Back Yard**	**8.8**	**8.9**	**1.470**
OSE16-F-C	OSE-16	Front Yard	11	10	1.522
OSE16-L-C	OSE-16	Left Yard	22	10	0.564
OSE17-B-C	OSE-17	Back Yard	22	13	0.507
OSE17-F-C	OSE-17	Front Yard	21	13	0.342
OSE18-B-C	**OSE-18**	**Back Yard**	**34**	**15**	**0.129**
OSE18-F-C	**OSE-18**	**Front Yard**	**23**	**19**	**0.289**
OSE18-G1	**OSE-18**	**Garden 1**	**69**	**21**	**0.106**
OSE18-G2	**OSE-18**	**Garden 2**	**59**	**17**	**0.115**
OSE18-R-C	OSE-18	Right Yard	18	14	0.365
OSE19-B-C	**OSE-19**	**Back Yard**	**33**	**16**	**1.012**
OSE19-F-C	**OSE-19**	**Front Yard**	**41**	**17**	**0.428**
OSE20-C	**OSE-20**	**Empty lot**	**32**	**27**	**0.365**
OSES1-C	OSES-1	Sub: OSE-12	21	18	0.376
OSES2-C	OSES-2	Sub: OSE-12	20	17	0.573
OSES3-C	OSES-3	Sub: OSE-12	16	21	0.321
Fairmont					
OSW8-B1-C	**OSW-8**	**Sub: B1**	**12**	**8.8**	**10.673**
OSW8-B2-C	**OSW-8**	**Sub: B2**	**9.1**	**8.5**	**12.913**
OSW8-D-1	**OSW-8**	**Dripline 1**	**8.8**	**8.5**	**460.1**
OSW8-D-2	**OSW-8**	**Dripline 2**	**16**	**20**	**982.2**
OSW8-D-3	**OSW-8**	**Dripline 3**	**14**	**13**	**705.1**
OSW8-D-4	**OSW-8**	**Dripline 4**	**6.6**	**8.7**	**651.6**
OSW8-F-C	**OSW-8**	**Front Yard**	**12**	**9.5**	**9.985**
OSW8-P1-C	**OSW-8**	**Sub: P1**	**14**	**8.9**	**3.540**
OSW8-P2-C	OSW-8	Sub: P2	10	9.4	0.936
OSW8-P3-C	OSW-8	Sub: P3	13	12	0.122
OSW8-P4-C	OSW-8	Sub: P4	9.5	9.6	0.238
OSW8-P5-C	OSW-8	Sub: P5	9.7	7.3	0.096
OSW8-P6-C	**OSW-8**	**Sub: P6**	**7.2**	**8.1**	**1.654**
OSW8-P7-C	OSW-8	Sub: P7	6	4.9	0.097
OSW8-P8-C	OSW-8	Sub: P8	8.9	8.4	0.125

TABLE 3-2

Summary of Concentrations used in the Risk Screening

Walter Coke Inc. - Birmingham, Alabama

Station ID	Property ID	Sample Yard/Location	Unseived Arsenic (mg/kg)	Seived Arsenic (mg/kg)	BaP Equivalents (mg/kg)
Fairmont (cont'd)					
OSW8-P9-C	OSW-8	Sub: P9	14	7.9	0.125
OSW13-P1-C	OSW-13	Play Area 1	12	8.5	0.168
OSW13-P2-C	OSW-13	Play Area 2	13	11	0.150
OSW14-P1-C	OSW-14	Play Area 1	18	7.5	0.180
OSW14-P2-C	OSW-14	Play Area 2	8.9	8.4	0.141
OSW14-P3-C	OSW-14	Play Area 3	7.3	6.1	0.191
OSW15-B-C	OSW-15	Back Yard	12	9	0.214
OSW15-F-C	OSW-15	Front Yard	10	8.7	0.228
OSW15-L-C	OSW-15	Left Yard	10	8.7	0.555
OSW16-B-C	OSW-16	Back Yard	8.2	6.5	0.396
OSW16-F-C	OSW-16	Front Yard	18	9.4	0.521
OSW16-L-C	OSW-16	Left Yard	11	7.6	0.189
OSW17-B-C	OSW-17	Back Yard	13	13	0.596
OSW17-F1-C	**OSW-17**	**Sub: Front Yard 1**	**30**	**20**	**0.198**
OSW17-F2-C	**OSW-17**	**Sub: Front Yard 2**	**23**	**12**	**0.169**
OSW17-L-C	**OSW-17**	**Left Yard**	**14**	**22**	**2.298**
OSW17-R-C	OSW-17	Right Yard	16	14	0.454

Notes:

mg/kg = Milligrams per kilogram

Sub: = 1/4 to 1/2 acre subdivision of a larger yard.

All samples collected from 0- to 6-inches in depth except gardens, play areas, and play area grab samples (0- to 12-inches in depth).

Bold text indicated the sample exceeded one or more target risk levels.

TABLE 3-3

Summary of Properties Where One or More Samples Exceeded One or More Target Risk Levels

Walter Coke Inc. - Birmingham, Alabama

Collegeville

Exceedance Property	No. of Samples Collected	No. of Samples Exceeded*
OSS-02	3	3
OSS-03	4	2
OSS-05	2	1
OSS-06	2	1
OSS-07	2	2
OSS-09	4	3
OSS-10	8	5
OSS-11	3	1
OSS-12	2	2
OSS-13	3	3
OSS-15	1	1
OSS-16	3	1
OSS-17	3	3
OSS-18	3	3
OSS-19	2	1
OSS-21	2	2
OSS-24	6	2
OSS-25	3	1
OSS-26	2	1
OSS-27	2	1
OSS-29	4	4
OSS-30	2	2
OSS-31	2	1
OSS-32	13	10
OSS-33	3	2
OSS-34	3	1
OSS-35	3	1
OSS-36	3	2
OSS-38	1	1
OSS-41	5	2

Additional Collegeville Properties (Selected by EPA)

Exceedance Property	No. of Samples Collected	No. of Samples Exceeded*
EPA-01	3	1
EPA-02	3	1
EPA-03	3	2
EPA-05	1	1
EPA-06	1	1
EPA-08	3	2

Harriman Park

Exceedance Property	No. of Samples Collected	No. of Samples Exceeded*
OSE-01	3	2
OSE-02	4	1
OSE-03	3	2
OSE-04	2	1
OSE-05	3	2
OSE-06	3	2
OSE-07	3	2
OSE-08	3	3
OSE-09	4	3
OSE-12	6	5
OSE-13	3	2
OSE-14	3	3
OSE-15	1	1
OSE-18	5	4
OSE-19	2	2
OSE-20	1	1

Fairmont

Exceedance Property	No. of Samples Collected	No. of Samples Exceeded*
OSW-8	16	8
OSW-17	5	3

Summary by Neighborhood

	Total # of Properties	# Exceeded	Percent Exceeded	Total # of Samples	# Exceeded	Percent Exceeded
Collegeville	49	36	73%	143	70	49%
Harriman Park	23	16	70%	60	36	60%
Fairmont	6	2	33%	32	11	34%

Notes:

The number of samples collected does not include quality assurance/quality control samples.

* See TABLE 3-2 for the samples that exceeded (indicated in bold).

🟩 Shaded properties exceeded only the Hazard Index for unseived arsenic and do not appear on Figures 3-1 through 3-3.

TABLE 3-4

Tukey's Multiple Comparison Results for Three Neighborhood's Grids

Walter Coke Inc. - Birmingham, Alabama

Arsenic					
Collegeville		Fairmont		Harriman Park	
Grid ID	Tukey Designation	Grid ID	Tukey Designation	Grid ID	Tukey Designation
A1	**A**	A1	A	A2	A
B1	A	B1	A	A3	A
B2	A	B2	A	A4	A
C1	A	C1	A	B1	A
C2	A	C3	A	B2	A
C3	A	C4	A	B3	A
C4	A	C5	**A**	B4	A
D1	**A**	D1	A	B5	A
D2	A	D2	A	C1	A
D4	A	D3	**A**	C2	A
D5	A			C4	A
D6	A			C5	**A**
D7	A			D1	A
D8	**A**			D2	A
D9	**A**			E1	A
E1	**A**				
E2	A				
E3	A				
E4	**A**				
E5	A				
E6	**A**				
E7	A				
E8	A				
F1	**A**				
F2	A				
F3	**A**				
F4	A				
F5	**A**				
G1	A				
G2	A				
G3	A				
H1	**A**				
H2	**A**				

BaP Equivalents					
Collegeville		Fairmont		Harriman Park	
Grid ID	Tukey Designation	Grid ID	Tukey Designation	Grid ID	Tukey Designation
A1	**A**	A1	A	A2	A
B1	A	B1	A	B5	A
B2	A	B2	A	A3	AB
C1	A	C1	A	A4	AB
C2	A	C3	A	B1	AB
C3	A	C4	A	B2	AB
C4	A	C5	**A**	B4	AB
D1	**A**	D1	A	C1	AB
D2	A	D2	A	C2	AB
D4	A	D3	**A**	C4	AB
D5	A			C5	**AB**
D6	A			D1	AB
D7	A			D2	AB
D8	**A**			E1	AB
D9	**A**			B3	B
E1	**A**				
E2	A				
E3	A				
E4	**A**				
E5	A				
E6	**A**				
E7	A				
E8	A				
F1	**A**				
F2	A				
F3	**A**				
F4	A				
F5	**A**				
G1	A				
G2	A				
G3	A				
H1	**A**				
H2	**A**				

Notes:

Bold values indicates only a single value available from this grid

🟦 Statistically different grids

BaP = Benzo(a)pyrene

TABLE 3-5

Tukey's Multiple Comparison Results for Collegeville Deposition Areas

Walter Coke Inc. - Birmingham, Alabama

Arsenic	
Collegeville	
Deposition Area	**Tukey Designation**
Outside *	A
10	A
20	A
30	A
40	A
50	A
60	A
70	A

BaP Equivalents	
Collegeville	
Deposition Area	**Tukey Designation**
Outside *	A
10	A
20	A
30	A
40	A
50	A
60	A
70	A

Notes:

* Outside Designated Deposition Areas (less than 10% deposition)

BaP = Benzo(a)pyrene

TABLE 3-6
Correlation of Arsenic and BaP Equivalents Concentrations

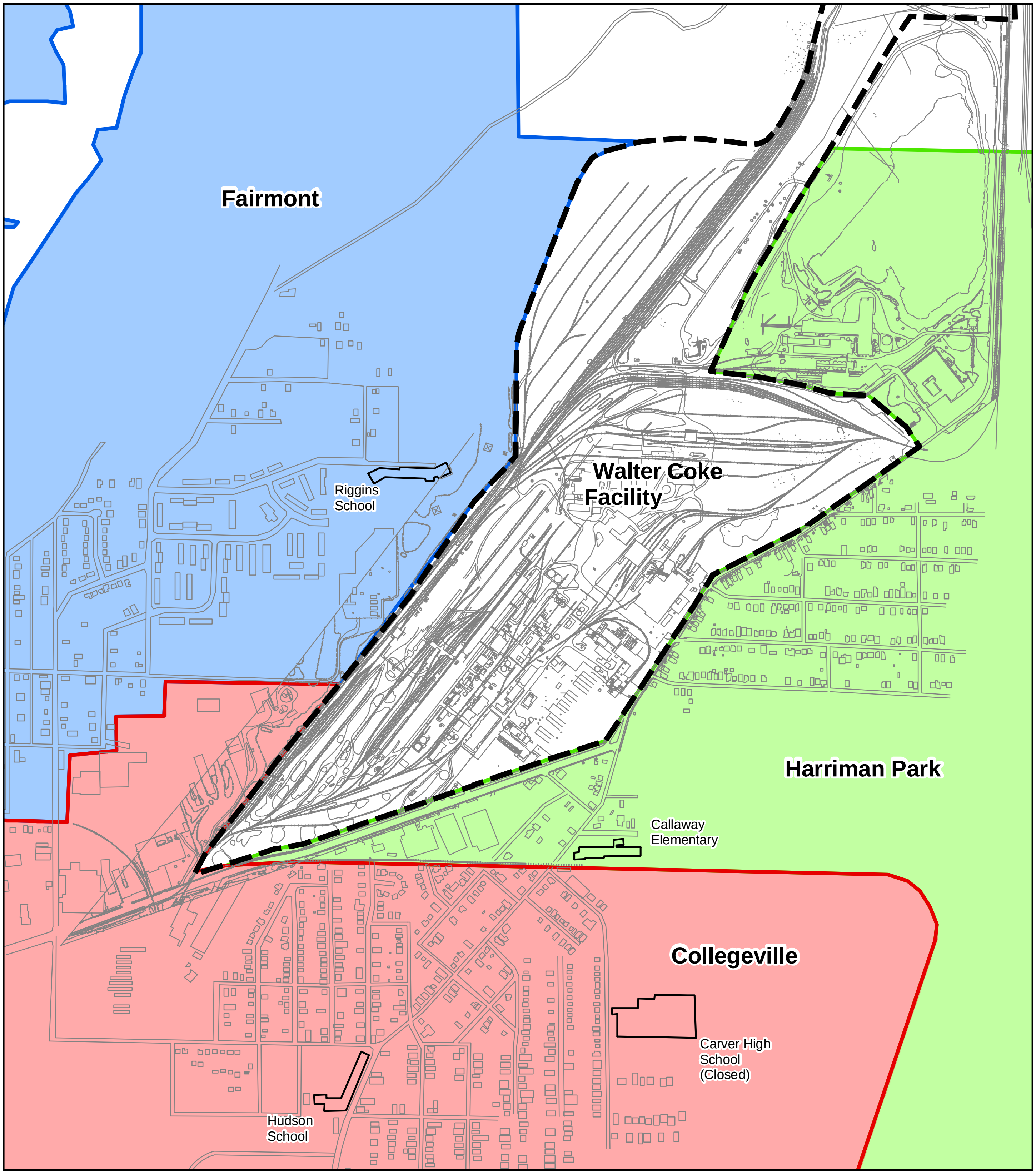
Walter Coke Inc. - Birmingham, Alabama

	Pearson		Spearman	
Data	Correlation Coefficient	Approximate Variability Explained	Correlation Coefficient	Approximate Variability Explained
All Results	-0.029	0.09%	0.165	2.7%
Minus 4 Elevated BaP Equivalents Values	-0.018	0.03%	0.184	3.4%
Log_{10} Transformed Results	0.100	1.0%	0.165	2.7%

Note:

BaP = Benzo(a)pyrene

Figures



Legend

▬ ▪ Walter Coke Facility Boundary

Neighborhood

🟥 Collegeville

🟩 Harriman Park

🟦 Fairmont

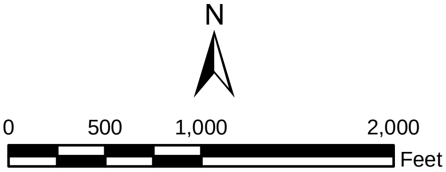


FIGURE 1-1
Walter Coke Facility and
Surrounding Neighborhoods
Residential Sampling Report
Walter Coke Inc.
Birmingham, Alabama

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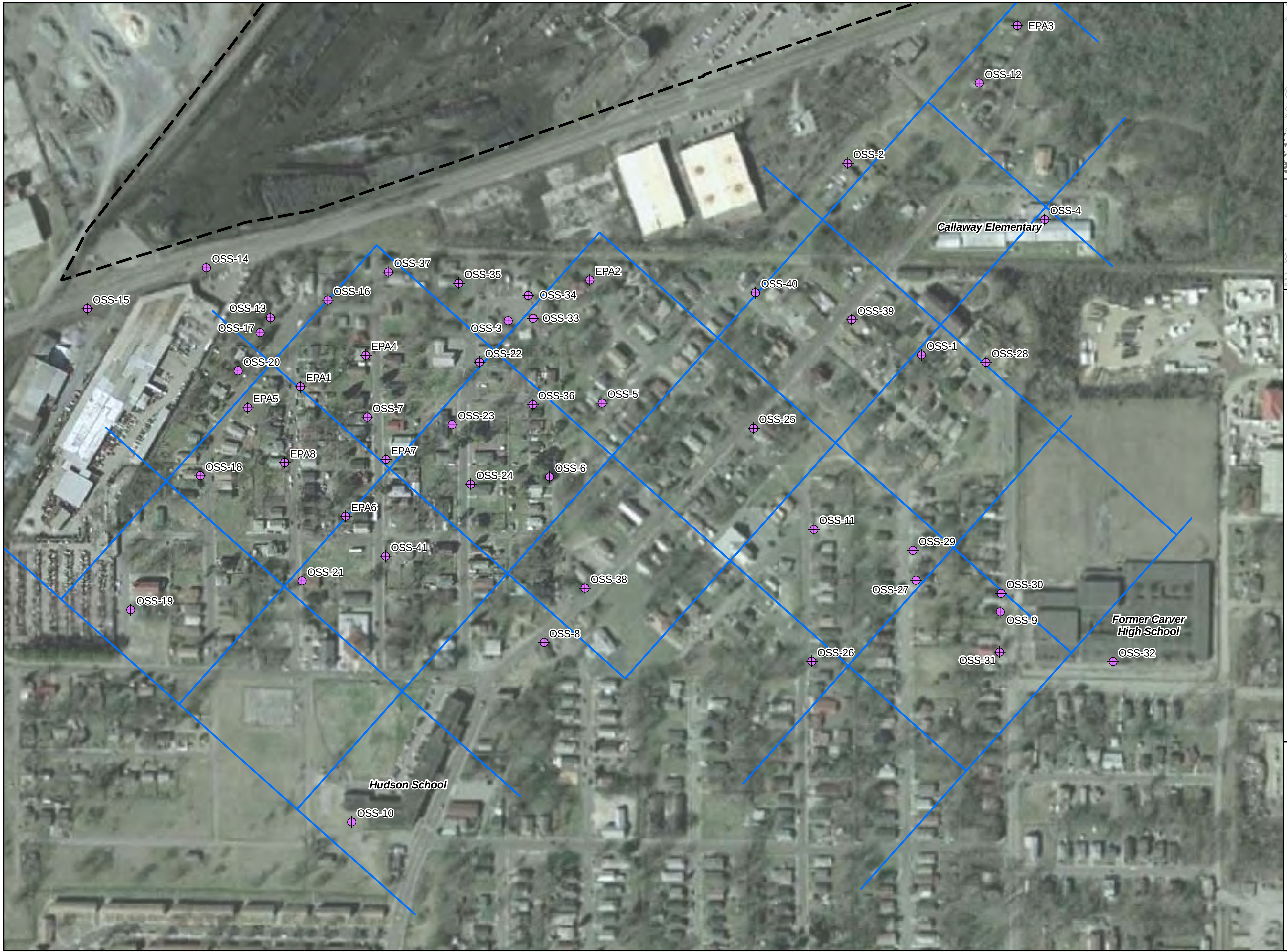

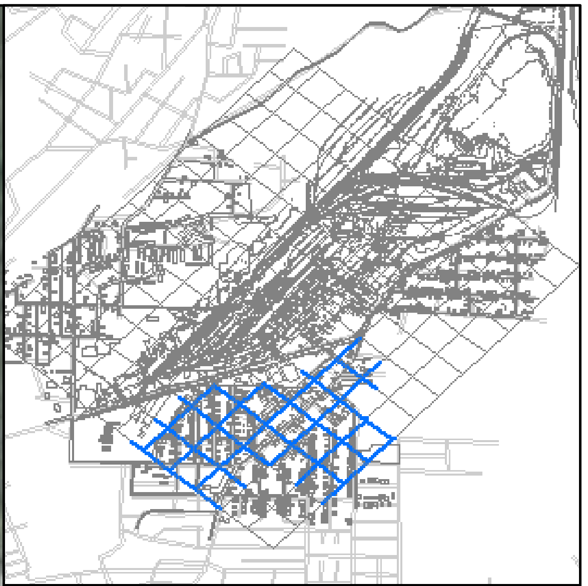

LEGEND

⊕ Property Sampled

— — Walter Coke Property Boundary

1 inch = 300 feet

FIGURE 1-2
Collegeville Properties

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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LEGEND

⊕ Property Sampled

— — Walter Coke Property Boundary

FIGURE 1-3
Harriman Park Properties

Walter Coke Inc.
Birmingham, Alabama

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LEGEND

⊕ Property Sampled

— — Walter Coke Property Boundary

1 inch = 300 feet

FIGURE 1-4
Fairmont Properties

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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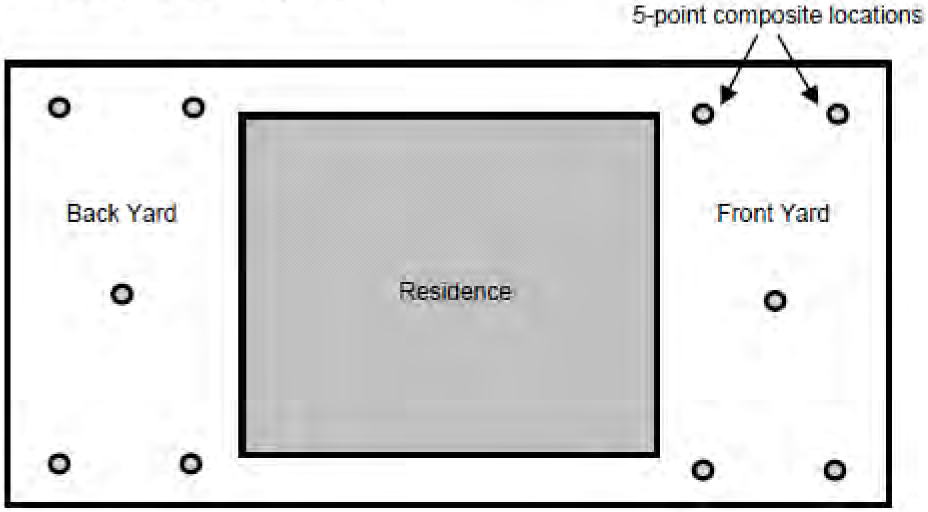
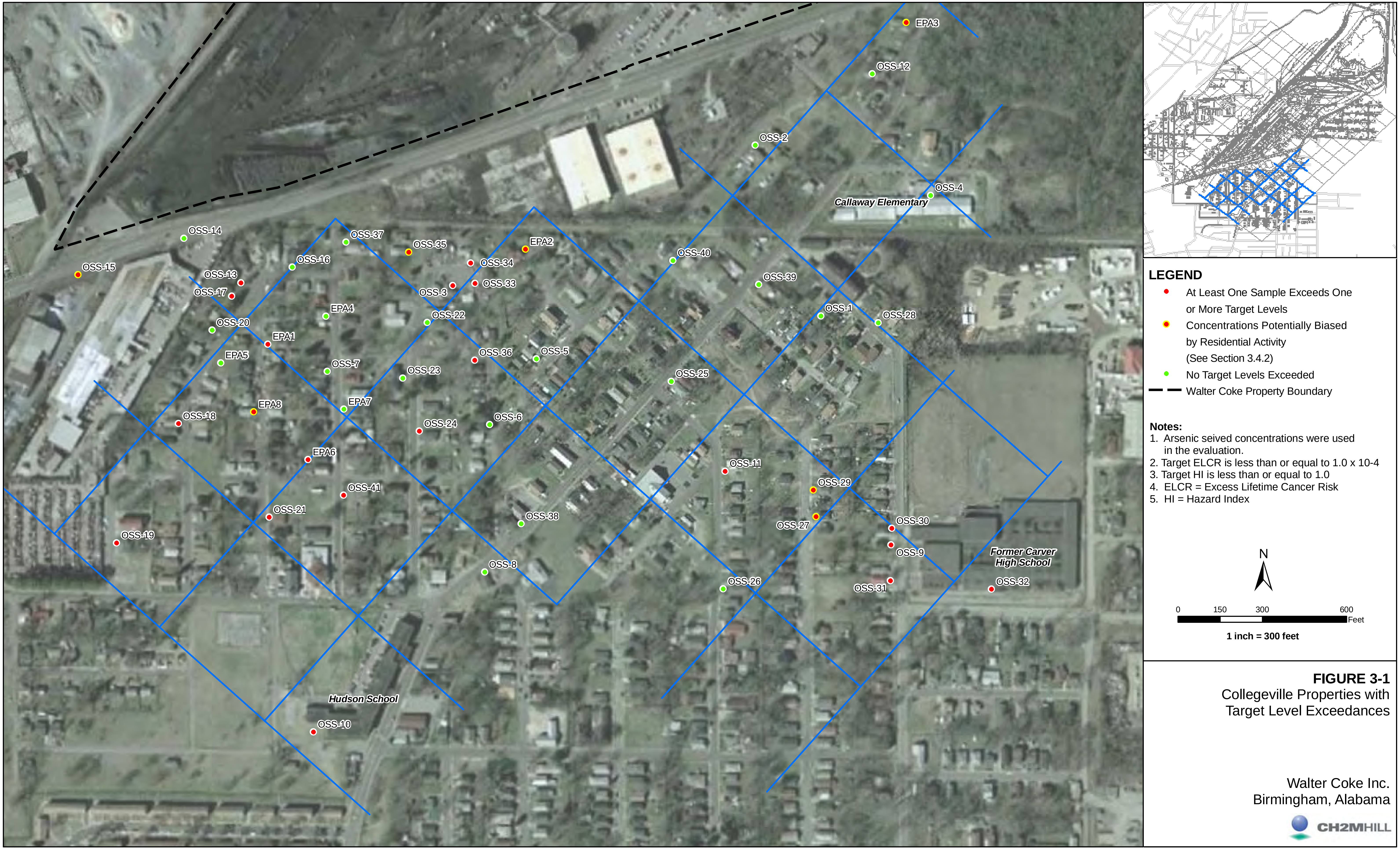
Figure 2-1
General Soil Sampling Layout in Residential Properties
Walter Coke, Inc. - Birmingham, AL





LEGEND

- 🔴 At Least One Sample Exceeds One or More Target Levels
- ● Concentrations Potentially Biased by Residential Activity (See Section 3.4.2)
- 🟢 No Target Levels Exceeded
- ▬ ▬ Walter Coke Property Boundary

Notes:

1. Arsenic seived concentrations were used in the evaluation.
2. Target ELCR is less than or equal to 1.0 x 10-4
3. Target HI is less than or equal to 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index

FIGURE 3-1
Collegeville Properties with
Target Level Exceedances

Walter Coke Inc.
Birmingham, Alabama

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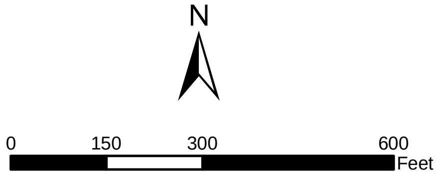
LEGEND

- ● At Least One Sample Exceeds One or More Target Levels
- ● No Target Levels Exceeded
- — — Walter Coke Property Boundary

Notes:

1. Arsenic seived concentrations were used in the evaluation.
2. Target ELCR is less than or equal to 1.0 x 10-4
3. Target HI is less than or equal to 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index



1 inch = 300 feet

FIGURE 3-2

Harriman Park Properties with Target Level Exceedances

Walter Coke Inc.
Birmingham, Alabama

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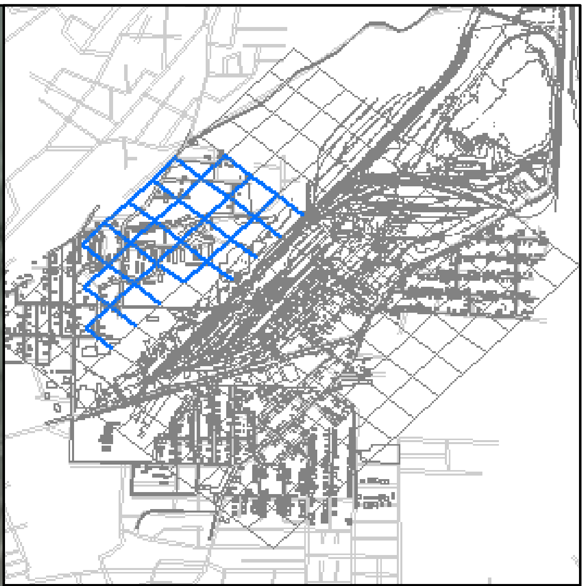

LEGEND

- 🔴 At Least One Sample Exceeds One or More Target Levels
- 🔴 Concentrations Potentially Biased by Residential Activity (See Section 3.4.2)
- 🟢 No Target Levels Exceeded
- — — Walter Coke Property Boundary

Notes:

1. Arsenic seived concentrations were used in the evaluation.
2. Target ELCR is less than or equal to 1.0 x 10-4
3. Target HI is less than or equal to 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index

N

0 150 300 600 Feet

1 inch = 300 feet

FIGURE 3-3
Fairmont Properties with
Target Level Exceedances

Walter Coke Inc.
Birmingham, Alabama

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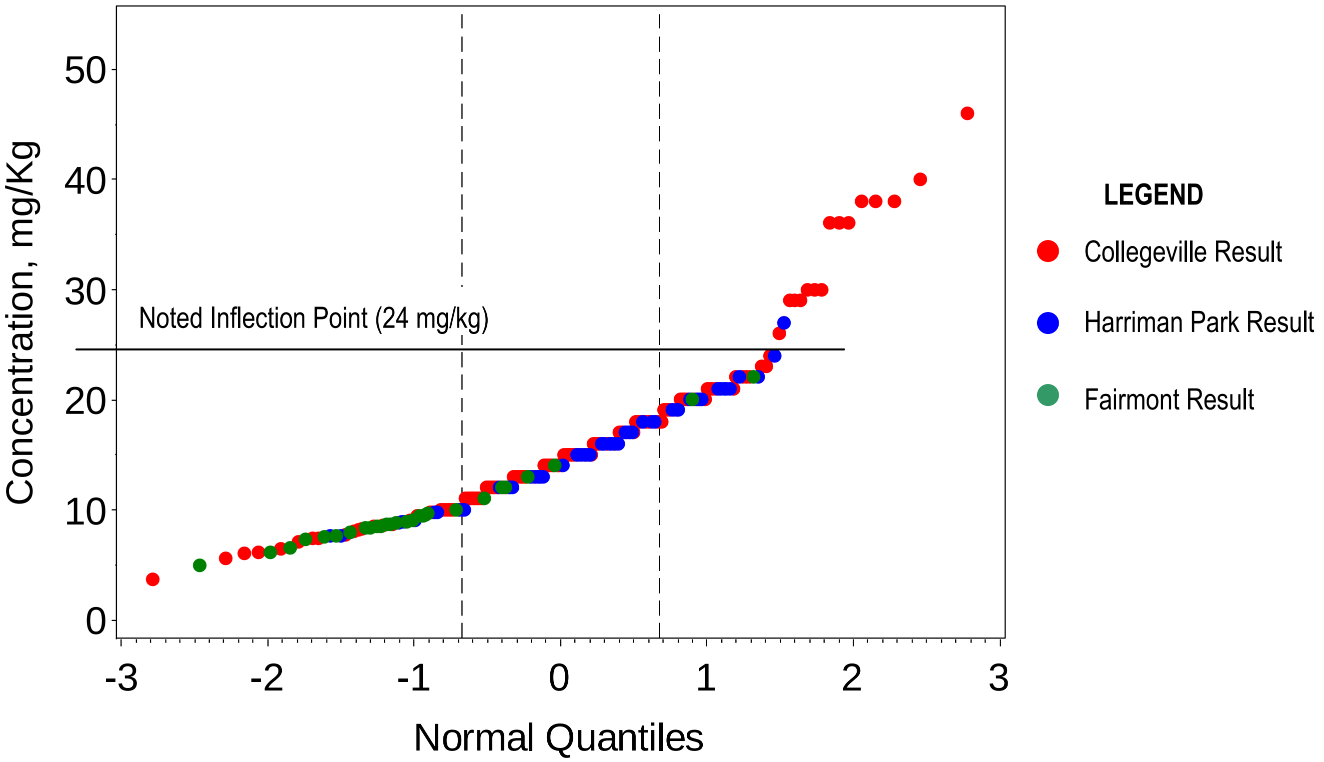
Probability Plot for Arsenic (sieved)



Probability Plot for BaP Equivalents

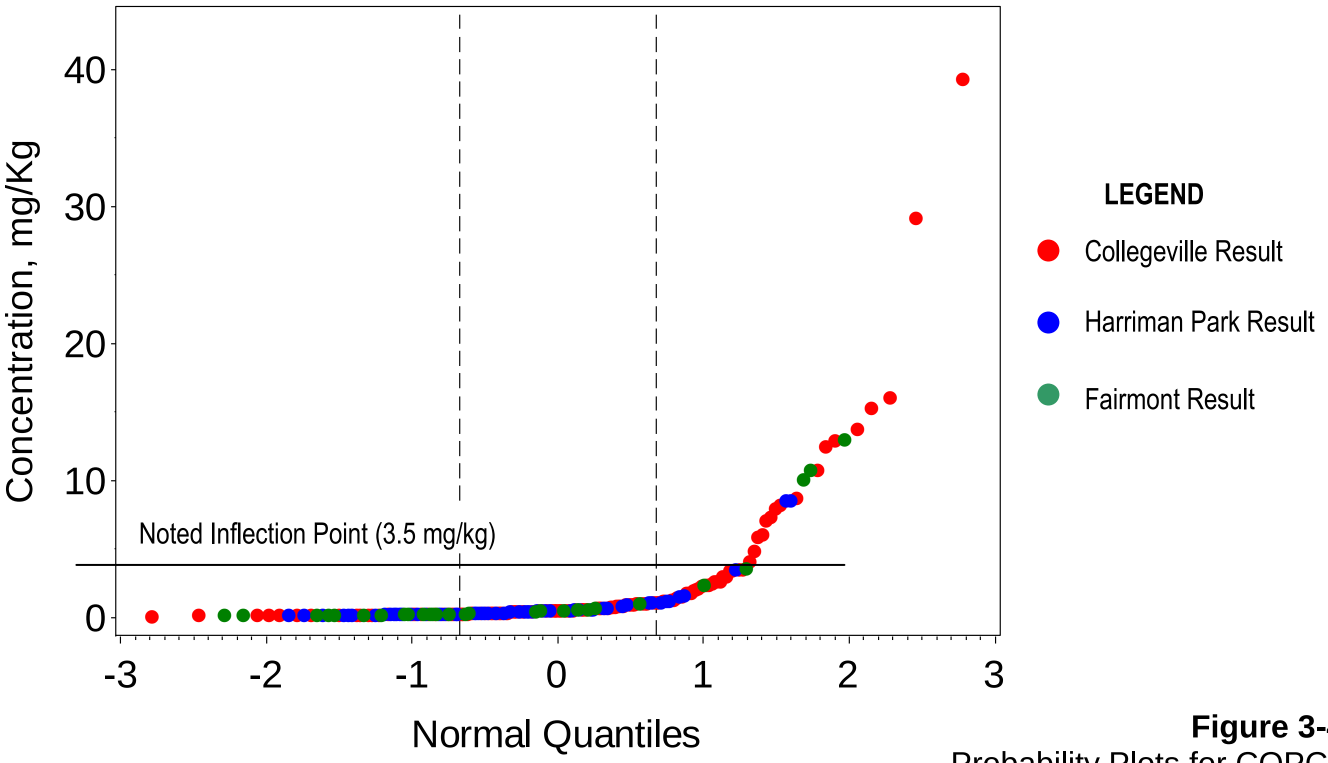
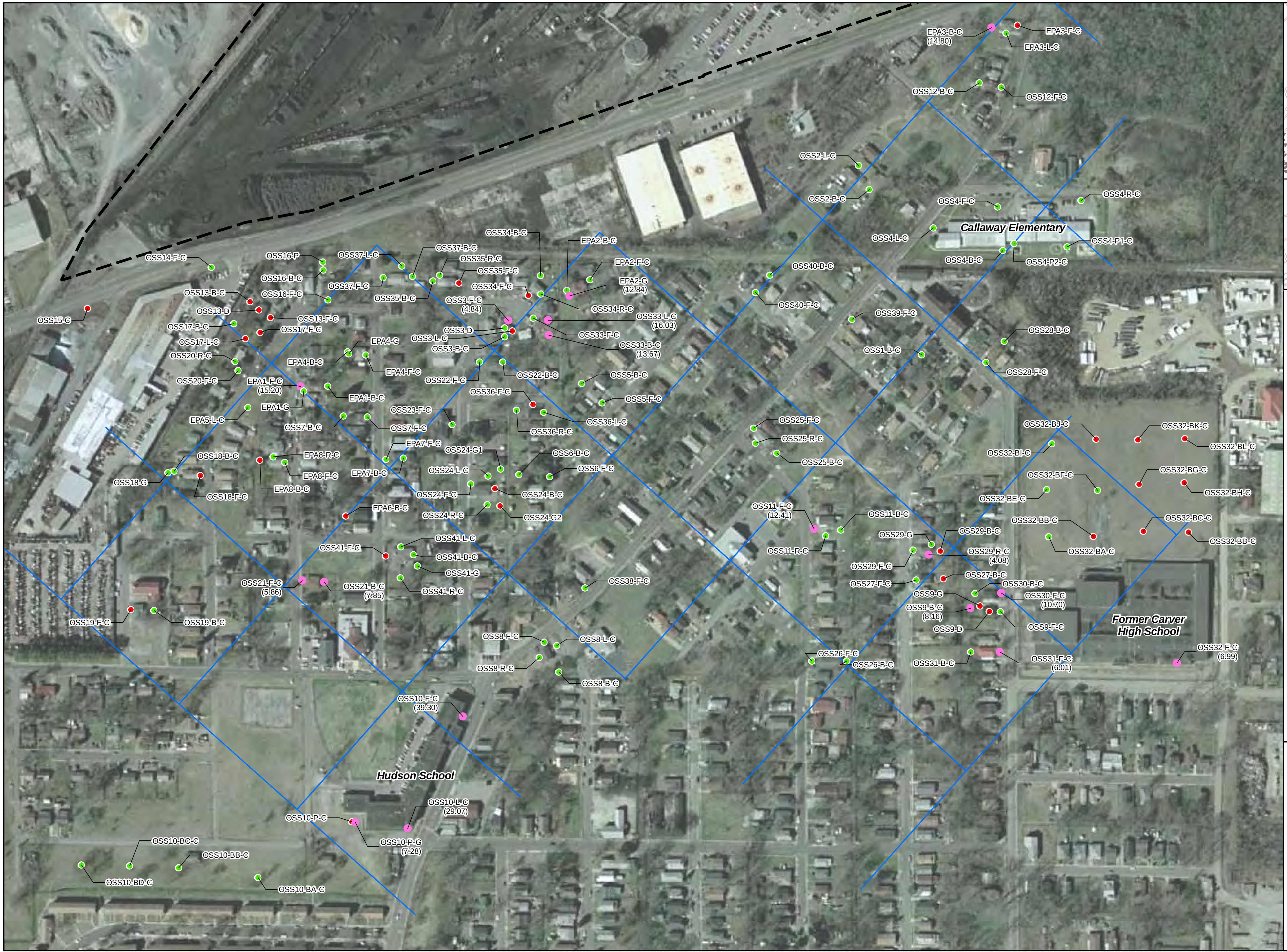


Figure 3-4
Probability Plots for COPCs
Residential Sampling Report
Walter Coke, Inc. – Birmingham, AL



LEGEND

- 🟢 Target Levels Not Exceeded
- 🔴 Exceeds One or More Target Levels
- ● Concentration of BaP Equivalents > 3.5 mg/kg
- — — Walter Coke Property Boundary

(6.99) BaP Equivalents Concentration (mg/kg)

Notes:

1. mg/kg = milligrams per kilogram
2. BaP = Benzo(a)pyrene
3. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index
6. 3.5 mg/kg is the calculated background concentation of BaP equivalents within the three neighborhoods.
7. Results greater than 3.5 mg/kg only are presented.

N

0 150 300 600
Feet

1 inch = 300 feet

FIGURE 3-5

BaP Equivalents Greater Than Background Value in Collegeville

Walter Coke Inc.
Birmingham, Alabama

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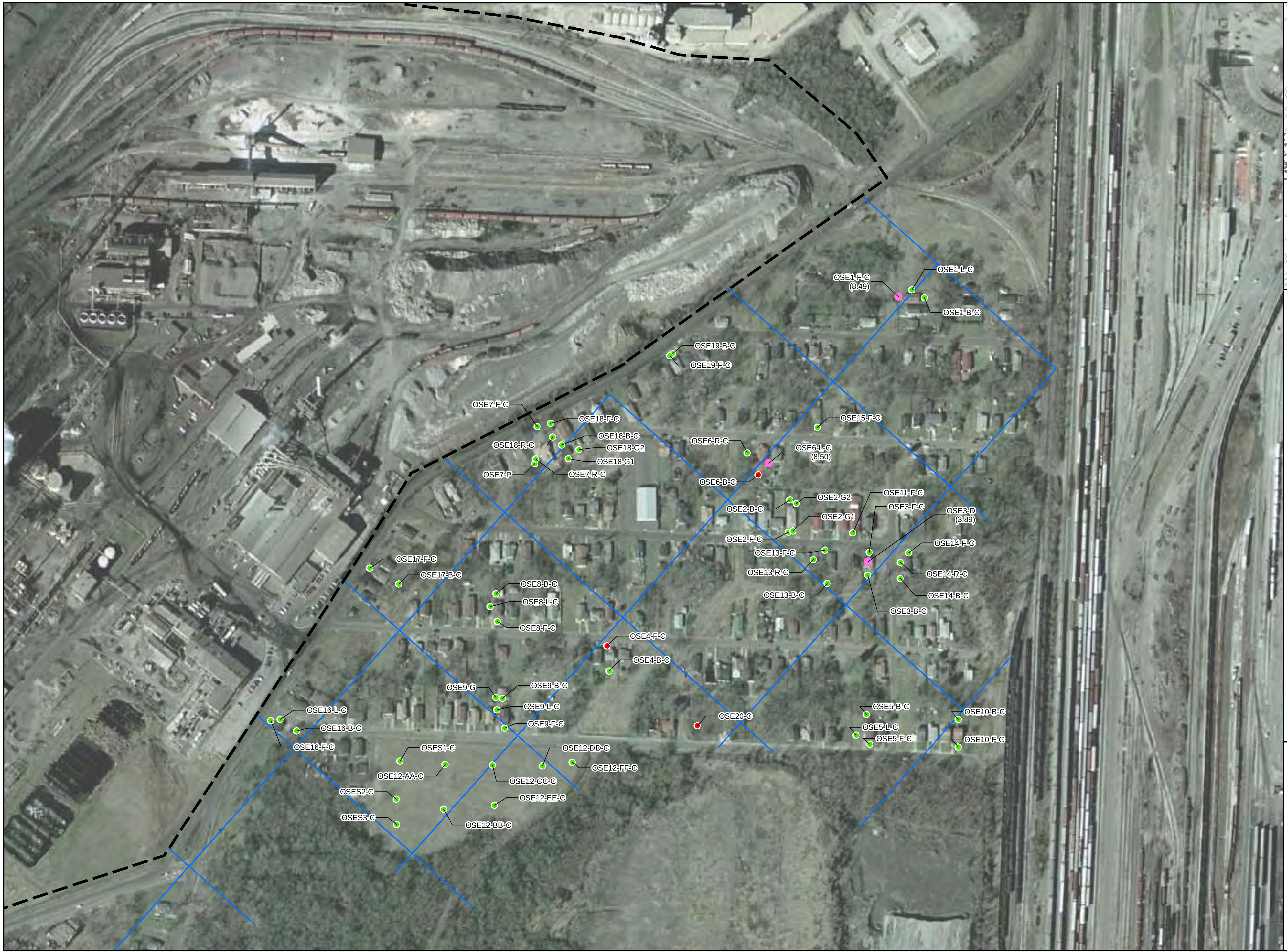

LEGEND

- ● Target Levels Not Exceeded
- ● Exceeds One or More Target Levels
- ● Concentration of BaP Equivalents > 3.5 mg/kg
- ▬ ▬ Walter Coke Property Boundary

(8.49) BaP Equivalents Concentration (mg/kg)

Notes:

1. mg/kg = milligrams per kilogram
2. BaP = Benzo(a)pyrene
3. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index
6. 3.5 mg/kg is the calculated background concentation of BaP equivalents within the three neighborhoods.
7. Results greater than 3.5 mg/kg only are presented.

N

0 150 300 600
Feet

1 inch = 300 feet

FIGURE 3-6
BaP Equivalents Greater Than Background Value in Harriman Park

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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LEGEND

- ● Target Levels Not Exceeded
- ● Exceeds One or More Target Levels
- ● Concentration of BaP Equivalents > 3.5 mg/kg
- ▬ ▬ Walter Coke Property Boundary

(9.98) BaP Equivalents Concentration (mg/kg)

Notes:

1. mg/kg = milligrams per kilogram
2. BaP = Benzo(a)pyrene
3. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index
6. 3.5 mg/kg is the calculated background concentation of BaP equivalents within the three neighborhoods.
7. Results greater than 3.5 mg/kg only are presented.

FIGURE 3-7
BaP Equivalents Greater Than
Background Value in Fairmont

Walter Coke Inc.
Birmingham, Alabama

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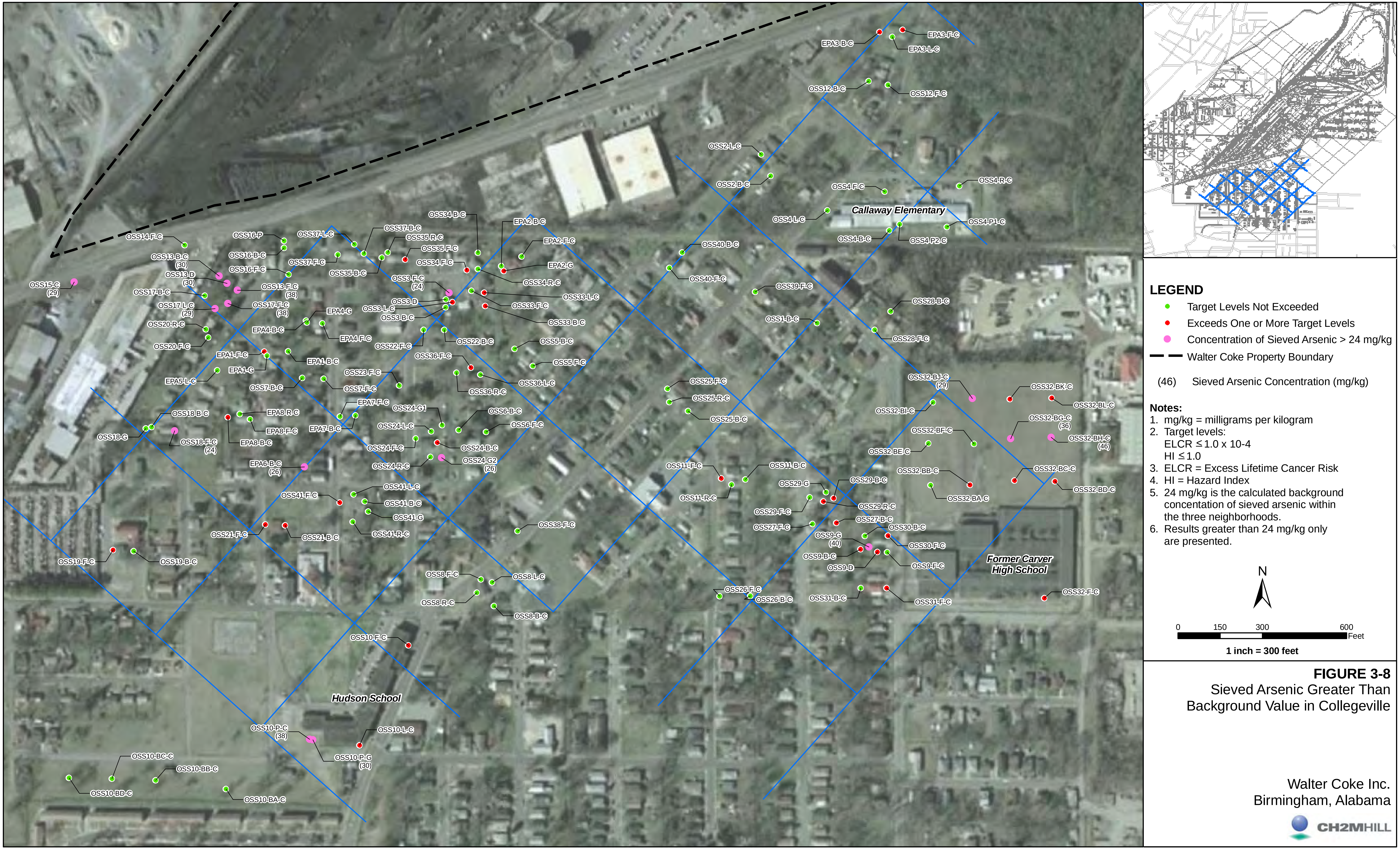

LEGEND

- 🟢 Target Levels Not Exceeded
- 🔴 Exceeds One or More Target Levels
- ● Concentration of Sieved Arsenic > 24 mg/kg
- — — Walter Coke Property Boundary

(46) Sieved Arsenic Concentration (mg/kg)

Notes:
1. mg/kg = milligrams per kilogram
2. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
3. ELCR = Excess Lifetime Cancer Risk
4. HI = Hazard Index
5. 24 mg/kg is the calculated background concentation of sieved arsenic within the three neighborhoods.
6. Results greater than 24 mg/kg only are presented.

1 inch = 300 feet

FIGURE 3-8
Sieved Arsenic Greater Than Background Value in Collegeville

Walter Coke Inc.
Birmingham, Alabama

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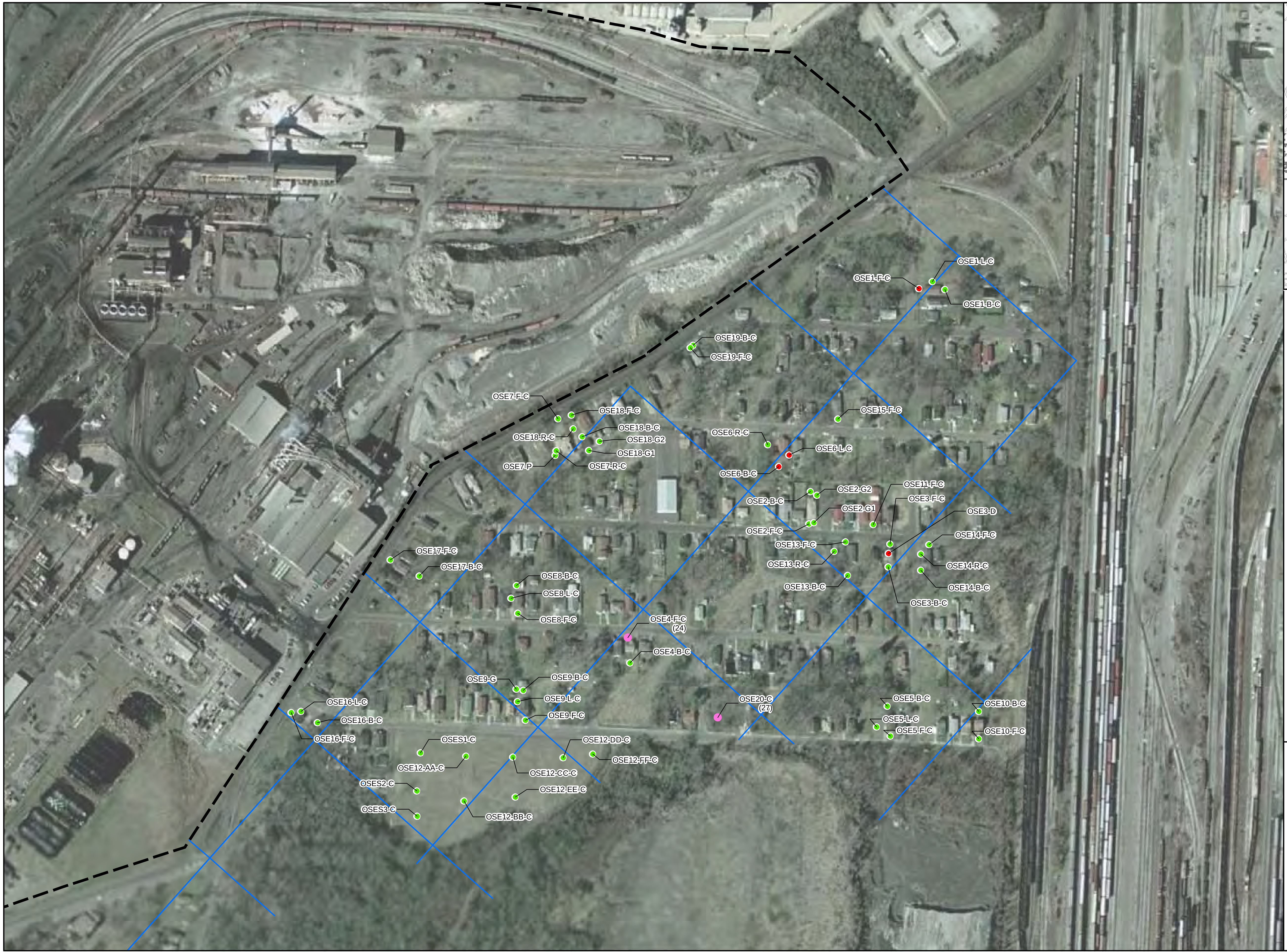

LEGEND

- 🟢 Target Levels Not Exceeded
- 🔴 Exceeds One or More Target Levels
- ● Concentration of Sieved Arsenic > 24 mg/kg
- ▬ ▬ Walter Coke Property Boundary

(27) Sieved Arsenic Concentration (mg/kg)

Notes:
1. mg/kg = milligrams per kilogram
2. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
3. ELCR = Excess Lifetime Cancer Risk
4. HI = Hazard Index
5. 24 mg/kg is the calculated background concentration of sieved arsenic within the three neighborhoods.
6. Results greater than 24 mg/kg only are presented.

N

0 150 300 600
Feet

1 inch = 300 feet

FIGURE 3-9
Sieved Arsenic Greater Than Background Value in Harriman Park

Walter Coke Inc.
Birmingham, Alabama

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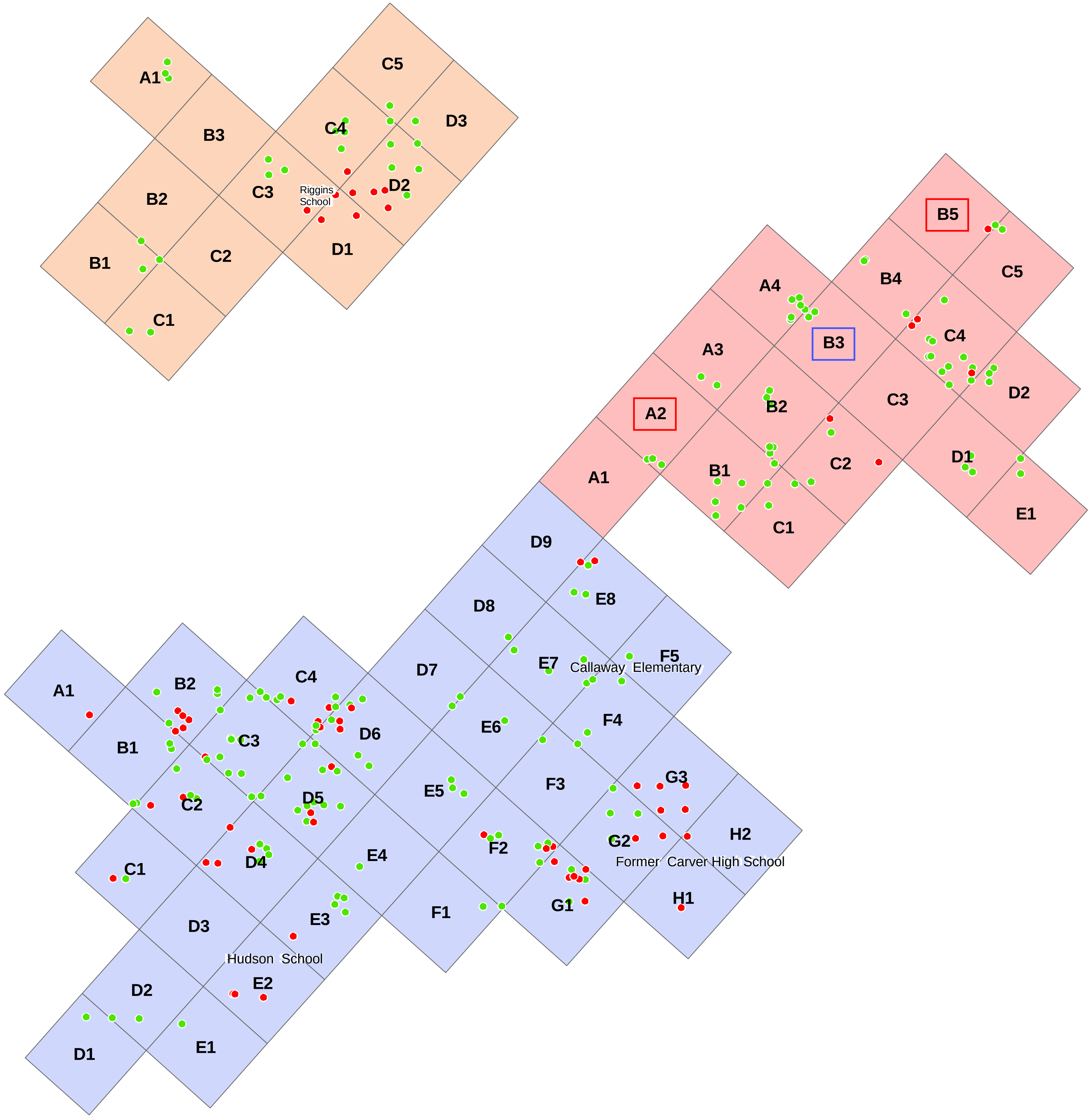

LEGEND

● Sample Exceeds One of More Target Levels
● No Target Levels Exceeded

Neighborhood

🟥 Harriman Park
🟦 Collegeville
🟧 Fairmont
☐ Statistically different grid (A designation)
☐ Statistically different grid (B designation)

Notes:

1. Target levels:
   ELCR less than or equal to
   1.0 x 10-4
   HI less than or equal to 1.0
2. ELCR = Excess
   Lifetime Cancer Risk
3. HI = Hazard Index

FIGURE 3-10
Grids Overlain onto the
Three Neighborhoods

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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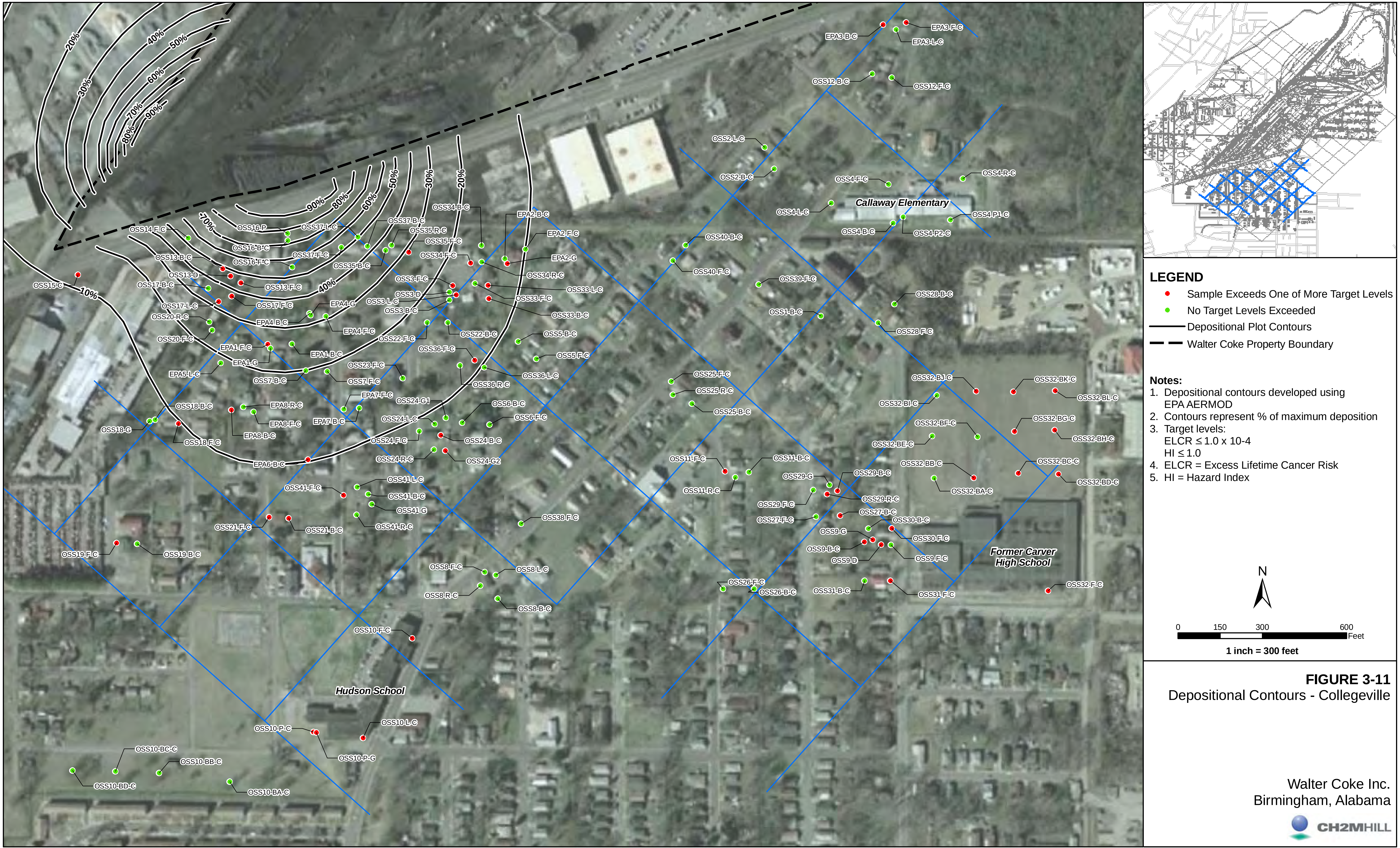

LEGEND

- 🟥 Sample Exceeds One of More Target Levels
- 🟩 No Target Levels Exceeded
- ━ Depositional Plot Contours
- ╍ Walter Coke Property Boundary

Notes:

1. Depositional contours developed using EPA AERMOD
2. Contours represent % of maximum deposition
3. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index

FIGURE 3-11
Depositional Contours - Collegeville

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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LEGEND

- 🟥 Sample Exceeds One of More Target Levels
- 🟩 No Target Levels Exceeded
- ─ Depositional Plot Contours
- ╍ Walter Coke Property Boundary

Notes:

1. Depositional contours developed using EPA AERMOD
2. Contours represent % of maximum deposition
3. Target levels:
   ELCR ≤ 1.0 x 10-4
   HI ≤ 1.0
4. ELCR = Excess Lifetime Cancer Risk
5. HI = Hazard Index

FIGURE 3-12
Depositional Contours - Fairmont

Walter Coke Inc.
Birmingham, Alabama

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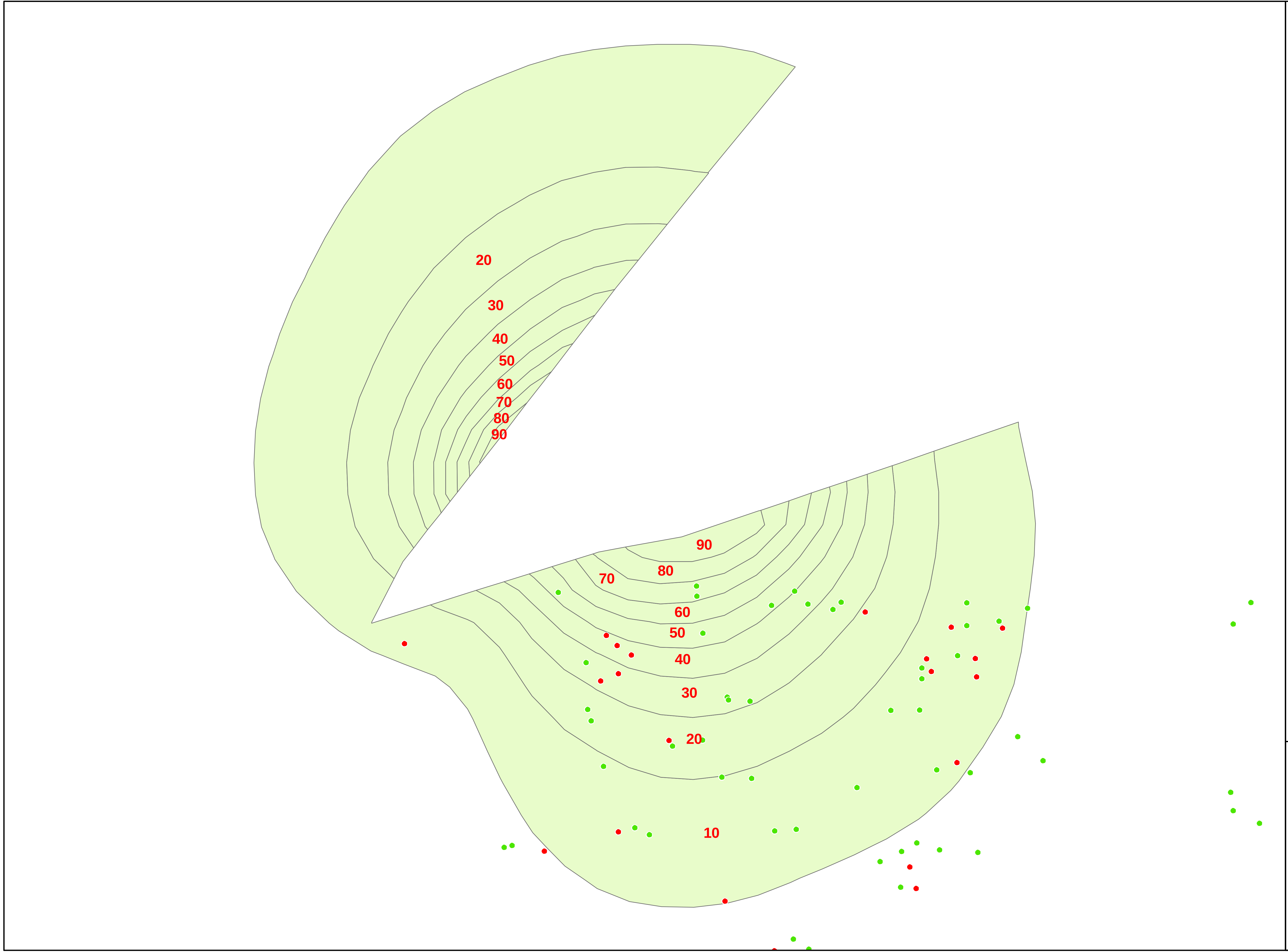

Legend

- ● Sample Exceeds One of More Target Levels
- ● No Target Levels Exceeded
- 🟩 Deposition Contour Area

Notes:

1. Target levels:
   ELCR less than or equal to
   1.0 x 10-4
   HI less than or equal to 1.0
2. ELCR = Excess
   Lifetime Cancer Risk
3. HI = Hazard Index

FIGURE 3-13
Collegeville Depositional Bands

Walter Coke Inc.
Birmingham, Alabama

CH2MHILL

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Correlation of Arsenic and BaP Equivalents (all results)

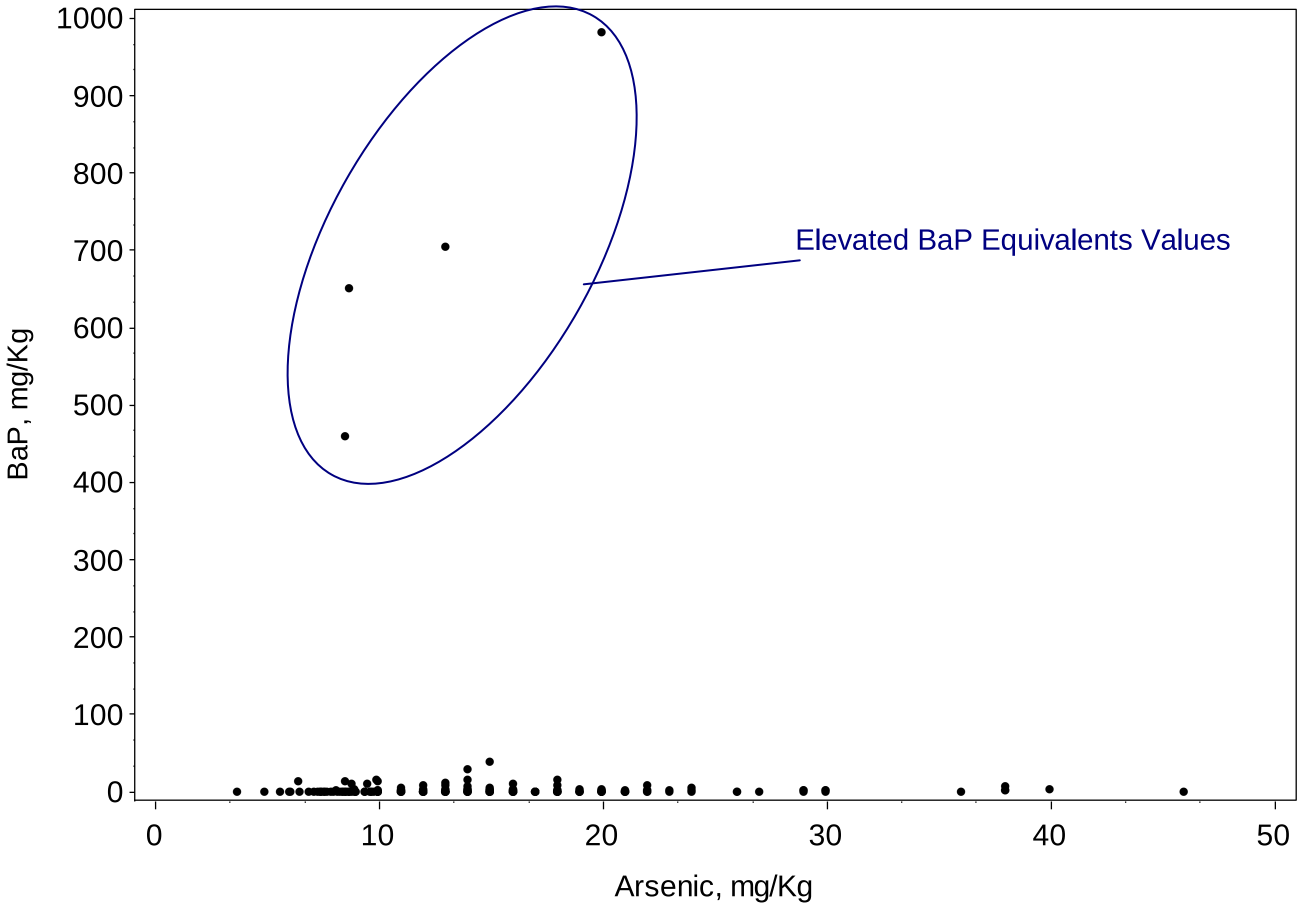

Figure 3-14
Correlation of Arsenic and BaP Equivalents (all results)
Residential Sampling Report
Walter Coke, Inc. – Birmingham, AL

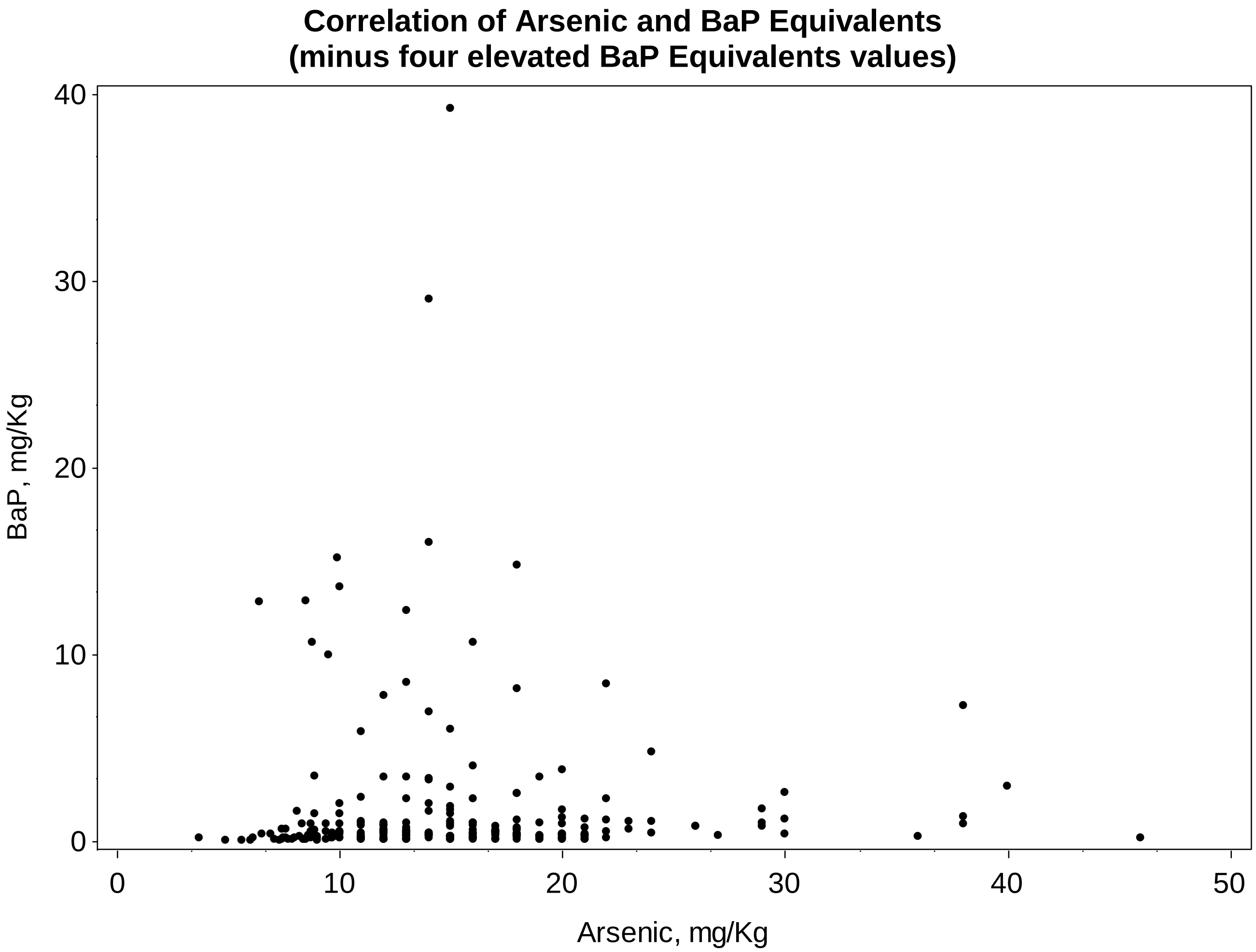

Figure 3-15
Correlation of Arsenic and BaP Equivalents
(minus four elevated BaP Equivalents values)
Residential Sampling Report
Walter Coke, Inc. – Birmingham, AL

Correlation of Arsenic and BaP Equivalents (Log$_{10}$ transformed values)

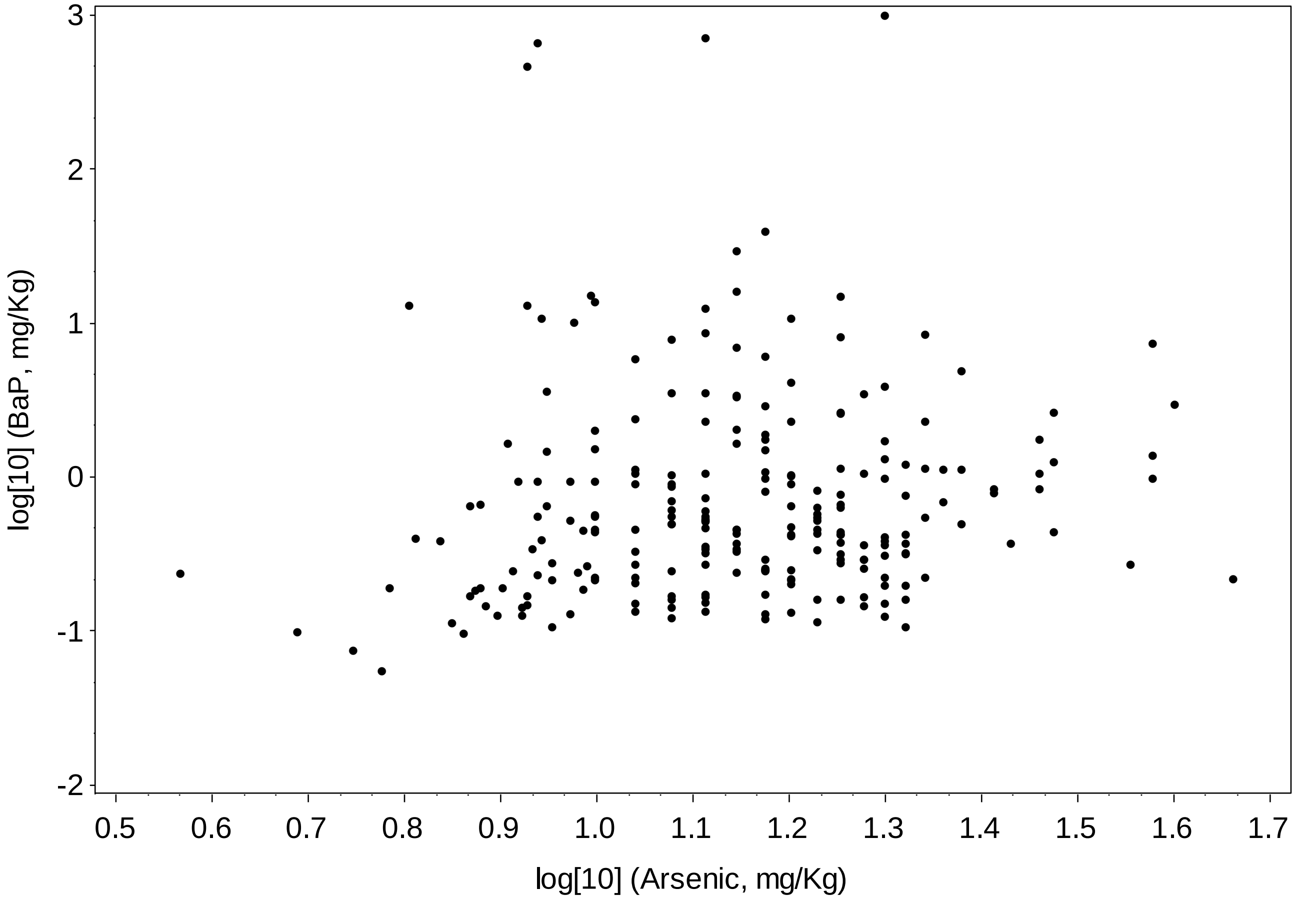

Figure 3-16
Correlation of Arsenic and BaP Equivalents
(Log$_{10}$ transformed values)
Residential Sampling Report
Walter Coke, Inc. – Birmingham, AL

APPENDIX A

Field Forms and Surveys

Collegeville

APPENDIX B

Data Quality Evaluation (DQE)

APPENDIX B

Walter Coke Residential Sampling, Birmingham, Alabama Data Quality Evaluation (DQE)

The purpose of the data quality evaluation (DQE) process is to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements; either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of matrix interferences is more subtle and involves the analysis of several areas of results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

Introduction

One hundred ninety-four composite soil samples, twenty-two grab soil samples, sixteen EPA composite soil samples, and three EPA grab soil samples were collected in three neighborhoods surrounding the Walter Coke Industries, Birmingham, Alabama facility from July 13 through July 28, 2009. These samples were collected as part of the residential soil sampling event. All samples were submitted daily during the sampling event to Test America Laboratory (TA) in Mobile, Alabama.

The number and type of samples collected are listed by analytical method in Table B-1. Field quality control (QC) samples collected included field duplicates (FD), matrix spike/matrix spike duplicates (MS/MSD), field blanks (FB), trip blanks (TB), and equipment rinsate blanks (EB). The samples were analyzed for the following analytical fractions:

- Low-level Polyaromatic Hydrocarbons (LL-PAH) by EPA SW-846 method 8270C-Low Level,
- Arsenic by EPA SW-846 6010B.

TABLE B-1
Analyses Totals by Method
Walter Coke, Inc. - Birmingham, Alabama

Analytical Method	Parameter	Soil, Composite	Soil, Grab	EPA, Composite	EPA, Grab	MS/ MSD	FD	EB	FB	Total
SW-846 8270C	LL-PAHs by GCMS	194	22	16	3	9	44	24	2	314
SW-846 6010B	Arsenic	194	22	16	3	9	44	24	2	314
SW-846 6010B	Sieved Arsenic	194	22	16	3	9	44	24	2	314

Samples submitted for LL-PAH analysis were analyzed for the following list of compounds: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. A portion of each arsenic soil sample received by the lab was sieved using #60 mesh prior to sample digestion. The arsenic soil samples collected in the field and the laboratory sieved arsenic samples were each digested and analyzed for arsenic.

Before the analytical results were released by the laboratory, both the sample and QC data were carefully reviewed to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data were reduced and the resulting data were reviewed to ascertain whether they were within the laboratory-defined limits for accuracy and precision.

The hardcopy data packages were reviewed by the project chemist using the process outlined in the EPA guidance document *National Functional Guidelines for Organic Data Review* (October, 1999) and *National Functional Guidelines for Inorganic Data Review* (July, 2004). EPA Level III deliverables were provided by the laboratory for this project. The areas of review included (when applicable to the method):

- chain of custody documentation
- holding times
- laboratory method and field blank analyses
- surrogate compound recoveries
- matrix spike compound recoveries and reproducibility
- bromofluorobenzene (BFB) mass tuning results
- initial and continuing calibration
- second source recoveries
- internal standard area performance summaries
- target compound identification
- laboratory control sample results
- interference check standards
- serial dilutions
- post spike recoveries
- laboratory and blind field duplicate sample results
- detection limits/sensitivity
- electronic data deliverables

A data review worksheet was completed for each of these data packages and any non-conformance documented. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes.

Data that were not within the acceptance limits were appended with a qualifying flag, which consists of a single or double-letter abbreviation that reflects a problem with the data. The following flags were used in this text:

- **U -** Undetected. Analyte was analyzed for but not detected above the method detection limit.
- **UB** – Undetected. Analyte reported as not detected at an elevated detection limit due to blank contamination.
- **UJ -** Detection limit estimated. Analyte was analyzed for, and qualified as not detected. The result is estimated.
- **J -** Estimated. The analyte was present, but the reported value may not be accurate or precise.
- **R -** Rejected. The data are unusable. (NOTE: Analyte/compound may or may not be present.)

Once the data review and validation process was completed, the entire data set were reviewed for chemical compound frequencies of detection, dilution factors that might affect data usability and patterns of target compound distribution. The data set was also evaluated to identify potential data limitations, uncertainties, or both in the analytical results.

Data validation qualifiers were applied to the detected and not detected results, as necessary. All sample results are maintained in an Access database and a complete data summary table is presented in Table B-2 at the end of this report.

Holding Times

The holding times for each parameter were evaluated according to EPA SW-846 method requirements. Holding times were met for all parameters analyzed for this sampling event.

Potential Field Sampling and Laboratory Contamination

Three types of blank samples were used to monitor potential contamination introduced during field sampling, sample handling, shipping activities, as well as sample preparation and analysis in the laboratory.

- **Equipment Rinsate Blank (ERB)**: A sample of the target-free water used for the final rinse during the equipment decontamination process. This blank sample is collected by rinsing the sampling equipment after decontamination and is analyzed for the same analytical parameters as the corresponding samples. This blank is used to monitor potential contamination caused by incomplete equipment decontamination. One equipment rinsate blank should be collected per day of sampling, per type of sampling equipment. Twenty-four equipment rinsate blanks for LL-PAH and arsenic were submitted to TA/Mobile laboratory for analysis.
- **Field Blank or Ambient Blank (FB or AB)**: The field blank is an aliquot of the source water used for equipment decontamination. This blank monitors contamination that may be introduced from the water used for decontamination. One field blank should be collected from each source of decontamination water and analyzed for the same parameters as the associated samples. Two field blank samples were submitted to TA/Mobile laboratory for LL-PAH and arsenic analysis.
- **Laboratory Method Blank or Method Blank (MB)**: A laboratory method blank is ASTM Type II water that is treated as a sample in that it undergoes the same analytical process as the corresponding field samples. Method blanks are used to monitor laboratory performance and contamination introduced during the analytical procedure. One method blank was prepared and analyzed for every twenty samples or per analytical batch, whichever was more frequent.

According to the EPA Functional Guidelines, concentrations of common organic contaminants detected in samples at less than ten times the concentration of the associated blanks can be attributed to field sampling and laboratory contamination rather than environmental contamination from site activities. Common organic contaminants include acetone, methylene chloride, 2-butanone, and the phthalates. For inorganic and other organic contaminants, five times the concentration detected in the associated blanks (rather than ten times) is used to qualify results as potential field and/or laboratory contamination rather than environmental contamination.

Field and laboratory blanks analyzed for this sampling event were reported as non-detects or less than five times the associated native sample concentrations for all parameters. Therefore no sample results were qualified due to blank contamination.

General Data Qualifiers

As required by U.S. EPA *Functional Guidelines for Evaluating Data Quality*, all reported values which were qualitatively identified at concentrations below their respective reporting limits (RL) but above the method detection limit (MDL) have been “J” qualified in Table B-2 Validated Analytical Results to indicate that they are quantitative estimates.

Instrument Calibration

Continuing calibration percent differences (%D) outside criteria were reported for benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene during the analysis of these samples. Continuing calibration exceedances indicate a lack of instrument stability, therefore a “J” qualifier was appended to the sample results associated with these exceedances to indicate that they are quantitative estimates.

Matrix Effects

Surrogate Spike Recovery and Internal Standard Response

Surrogate spike compounds were added to every sample, including field and laboratory blanks as well as field environmental samples and analyzed for PAHs. Surrogate spikes consist of organic compounds which are similar to the method targets in chemical composition and behavior in the analytical process, but which are not normally found in environmental samples.

Surrogate spike recoveries were used to monitor both laboratory performance and matrix interferences. Surrogate spike recoveries from field and laboratory blanks were used to evaluate laboratory performance because the blanks should represent an "ideal" sample matrix. Surrogate spike recoveries for the field samples were used to evaluate the potential for matrix interferences. According to *Functional Guidelines*, SVOC results are not qualified unless two or more surrogates, within the same fraction (base/neutral or acid fraction), are out of acceptance criteria.

For this data set, all surrogate recoveries were within method criteria.

Internal standard calibration involves the comparison of the instrument responses from the target compounds in the sample to the responses of specific standards added to the sample or sample extract prior to injection. Internal standard responses below criteria were reported for 8 PAH samples indicating the possible presence of matrix interference and biased low sample results. A “J” qualifier was appended to the PAH results for these samples to indicate that the reported values are quantitative estimates due to poor internal standard responses.

Matrix Spike/Matrix Spike Duplicate Precision and Accuracy and Field Duplicates

A matrix spike (MS) is an aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A MS is used to document the bias of a method in a given sample matrix. The matrix spike duplicate (MSD) is a sample spiked with identical concentrations of target analyte(s) as the matrix spike. MS/MSDs are used to document the precision and bias of a method in a given sample matrix. For the MS/MSD measurement, three aliquots of a single sample are analyzed; one native sample and two samples spiked with target analytes or compounds. Matrix accuracy is evaluated from the spike recoveries, while precision is evaluated from comparison of the percent recoveries of the MS and MSD.

Organic results are not qualified upon the results of MS/MSD results alone. Evaluation is in conjunction with LCS/LCSD, surrogate, and internal standard (if applicable) results. Table B-3 contains the native sample locations for the 9 MS/MSD sample sets submitted to the laboratory for PAH, arsenic, and sieved arsenic analysis. Most PAH and arsenic accuracy and precision results were within established MS/MSD and LCS/LCSD criteria. Ten sample results, which included 1 arsenic, 2 sieved arsenic, and 7 PAH results were “J” qualified due to MS/MSD outside criteria. Thirty-one sample results, 5 sieved arsenic and 26 PAH results were “J” qualified due to LCS/LCSD outside criteria. The reported values for these samples should be considered quantitative estimates due to the MS/MSD and/or LCS/LCSD exceedances.

Forty-four field duplicate samples along with their associated native samples were submitted to the laboratory to evaluate sampling and analytical precision for those compounds/analytes determined to be confidently detected. Table B-3 list the native sample locations for the field duplicate samples collected during this sampling event.

TABLE B-3
Quality Assurance/Quality Control Samples Collected Per Property
Walter Coke, Inc. - Birmingham, Alabama

Collegeville	
Sample Location	**QA/QC**
OSS-01	FD16
OSS-02	FD17
OSS-05	FD19
OSS-06	MS/MSD
OSS-07	FD20
OSS-08	FD21
OSS-10	FD09,FD22
OSS-11	FD23
OSS-13	FD24
OSS-16	FD26
OSS-17	FD12
OSS-18	FD28
OSS-21	MS/MSD
OSS-23	FD31
OSS-24	MS/MSD
OSS-25	FD32
OSS-26	FD33
OSS-28	FD35
OSS-29	FD36
OSS-31	FD37
OSS-33	FD38
OSS-34	FD30
OSS-35	FD39
OSS-36	MS/MSD
OSS-37	FD40
OSS-38	FD41
OSS-39	MS/MSD
OSS-40	FD42
OSS-41	FD43

Harriman Park	
Sample Location	**QA/QC**
OSE-01	FD01
OSE-02	FD02, FD03
OSE-04	FD04
OSE-05	FD05
OSE-06	MS/MSD
OSE-07	FD45
OSE-08	FD46
OSE-10	FD08
OSE-12	MS/MSD
OSE-13	FD10
OSE-15	MS/MSD
OSE-16	FD11
OSE-18	FD27
OSE-19	FD13
OSE-20	FD14
OSES-2	FD15

Fairmont	
OSW-16	MS/MSD

EPA	
EPA-1	FD25
EPA-3	FD49

Relative percent differences (RPD) were calculated for samples results detected above the reporting limit for both the native and field duplicate sample. All compounds/analytes were within soil duplicate precision criteria (less than 35% difference) with the exception of the following:

- 0709-EPA1-F-C/0709-EPA1-FD25 collected 7/24/09 – arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- 0709-EPA3-B-C/0709-EPA3-FD49 collected 7/23/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

- 0709-OSE4-F-C/0709-OSE04-FD04 collected 7/24/09 – arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene.
- 0709-OSE16-F-C/0709-OSE16-FD11 collected 7/23/09 – benzo(a)pyrene, benzo(k)fluoranthene, and chrysene.
- 0709-OSE19-F-C/0709-OSE19-FD13 collected 7/23/09 – arsenic.
- 0709-OSES2-C/0709-OSES02-FD15 collected 7/25/09 – chrysene.
- 0709-OSS07-B-C/0709-OSS07-FD20 collected 7/14/09 – benzo(b)fluoranthene.
- 0709-OSS10-P-G/0709-OSS10-FD09 collected 7/21/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- 0709-OSS13-F-C/0709-OSS13-FD24 collected 7/13/09 – benzo(b)fluoranthene.
- 0709-OSS17-B-C/0709-OSS17-FD12 collected 7/13/09 – benzo(k)fluoranthene.
- 0709-OSS28-B-C/0709-OSS28-FD35 collected 7/16/09 – arsenic.
- 0709-OSS33-F-C/0709-OSS33-FD38 collected 7/24/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene.
- 0709-OSS34-B-C/0709-OSS34-FD30 collected 7/15/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene.
- 0709-OSS41-F-C/0709-OSS41-FD43 collected 7/14/09 – benzo(a)pyrene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene.
- 0709-OSW08-F-C/0709-OSW08-FD44 collected 7/25/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- 0709-OSW17-L-C/0709-OSW17-FD09 collected 7/28/09 – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-cd)pyrene.

The inconsistency between the native and field duplicate sample results should be noted when assessing the quantitative results for these samples. A “J” qualifier was appended to the native and field duplicate results for the samples and compounds listed above due to the field duplicate precision exceedances. Field duplicate summaries for each of the samples detailed above are available upon request.

Dilutions

Numerous samples required analysis or re-analysis at dilutions during the PAH and arsenic analyses. These dilutions were required to prevent saturation of the instrument, to allow quantitation of the compounds within the linear range of the calibration curve, and/or to reduce the effects of the matrix on the target compounds. When possible non-detected results and results below the instruments linear range were reported from the original analysis and those compounds exceeding the instruments linear range reported from the diluted analyses. For samples where an undiluted analysis was not possible, higher quantitation limits were reported for compounds which were not detected in the diluted samples. This should be noted when assessing these samples for the qualitative absence of specific organic compounds.

Other

Several coolers containing samples collected on July 17, 2009 were delayed by Fed-Ex and arrived at the laboratory on July 20, 2009 with melted ice and above 4 ± 2°C. Numerous composite samples were received above temperature criteria; however the associate discrete samples for 5 locations were received within temperature requirements. The laboratory generated a composite sample from the associated discrete sample for these samples on July 22, 2009: OSE11-F-C, OSES3-B-C, OSE3-F-C, OSE9-L-C, OSS10-BB-C, OSS10-L-C, OSS04-F-C, OSS04-L-C, and OSS04-R-C. The following composite and associated discrete samples were received above temperature criteria and were recollected by the field team: 0709-OSE3-D, 0709-OSE5-B-C, 0709-OSE5-F-C, 0709-OSE5-L-C, 0709-OSE9-G, 0709-OSS10-F-C, and 0709-OSS10-P-C.

PARCCs

Precision--is defined as the agreement between duplicate results, and was estimated by comparing duplicate matrix spike recoveries and field duplicate sample results. Numerous field duplicate RPDs were outside precision criteria, indicating possible sample heterogeneity and/or matrix interferences for samples collected in similar locations.

Accuracy--is a measure of the agreement between an experimental determination and the true value of the parameter being measured. For the organic analyses, each of the samples was spiked with a surrogate compound and MS, MSD, LCS, and LCSD samples were spiked with a known reference material before preparation. MS/MSD and surrogate results establish precision and accuracy of the matrix, while the LCS results demonstrate accuracy of the method and the laboratory’s ability to meet the method criteria. Several samples results were qualified due to MS/MSD and/or LCS/LCSD exceedances. Overall, the accuracy acceptance criteria were met and there was no evidence of matrix interferences that would affect the usability of these data.

Representativeness--this criterion is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter and is used to evaluate the efficacy of the sampling plan design. Representativeness was demonstrated by providing full descriptions in the project scoping documents of the sampling techniques and the rationale used for selecting sampling locations.

Completeness--is defined as the percentage of measurements that are judged to be valid compared to the total number of measurements made. Data rejected during this evaluation included those samples which required multiple dilutions due to high native concentrations, as there can only be a single numerical result for compound/analyte reported. Overall, sample analyses were performed within QA/QC criteria resulting in greater than 95% usable data for this sampling event.

Comparability--is another qualitative measure designed to express the confidence with which one data set may be compared to another. Factors that affect comparability are sample collection and handling techniques, sample matrix type, and analytical method. Comparability is limited by the other PARCC parameters because data sets can be compared with confidence only when precision and accuracy are known. Data from this investigation are comparable with other data collected at the site because only EPA approved methods were used to analyze the samples and EPA Level II and III QC data are available to support the quality of the data.

Summary and Conclusions

Conclusions of the data quality evaluation process include:

- The laboratory analyzed the samples according to the approved EPA methods requested by the project as demonstrated by the data deliverables provided.
- Holding times were met for all analyses.

- Sample results for target compounds/analytes above the MDL but less than the RL were "J" qualified and should be considered as uncertain but indicative of the presence of that compound/analyte at an estimated concentration.

- Continuing calibration percent differences outside method criteria were reported for several PAHs during the analysis of these samples. Relative response factor (RRF) exceedances during continuing calibration indicates a lack of instrument stability, therefore a "J" qualifier was appended to the reported values for these compounds to indicate that they are quantitative estimates.

- Most spike recoveries were within the method acceptance limits requiring minimal data qualification when compared to the number of sample sets submitted. A "J" qualifier was appended to positive sample results for those samples with MS/MSD and/or LCS/LCSD recoveries outside laboratory criteria and to not detected samples results for those samples with recoveries below criteria to indicate that the reported values are quantitative estimates.

- Forty-four field duplicate samples along with their associated native samples were submitted to the laboratory to evaluate sampling and analytical precision for those compounds determined to be confidently detected. RPDs for numerous native and field duplicate sample sets were reported above 35 percent criteria. A "J" qualifier was appended to the native and field duplicate results for these samples due to the field duplicate precision exceedances. The inconsistency between the native and field duplicate sample results should be noted when assessing the quantitative results for these samples.

- Numerous samples required analysis or re-analysis at dilutions during PAH and arsenic analysis. These dilutions were required to prevent saturation of the instrument, to allow quantitation of the compounds within the linear range of the calibration curve, and/or to reduce the effects of the matrix on the target compounds. The laboratory reported both the native and diluted analyses of each sample. During data evaluation, the target compound results were taken from the dilution yielding concentrations near the mid-point of the instrument's linear range. Due to high target compound concentrations in some samples, higher quantitation limits were reported for other compounds that were not detected in the diluted sample.

The overall project objectives or PARCCs were met, and the data can be used in the project decision-making process as qualified by the data quality evaluation process and presented in Table B-2 Validated Analytical Results.

Tables

APPENDIX C

Photo Documentation