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ENVIRONMENT

Ms. Carolyn Bury
U.S. Environmental Protection Agency
777 West Jackson Boulevard
Mail Code DE9J
Chicago, IL 60604-3590

Subject:
Former Koppers Wood-Treating Site Human Health Risk Assessment Work Plan
Carbondale, Illinois

Date:
October 1, 2014

Contact:
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Our ref:
B0039301.0000

Dear Ms. Bury:

On behalf of Beazer East, Inc. (Beazer), ARCADIS U.S. Inc. (ARCADIS) has prepared this Revised Work Plan for the Human Health Risk Assessment (HHRA) for the Former Koppers Wood-Treating Site (Site) located in Carbondale, Illinois which includes the revisions on the draft Work Plan discussed between Beazer and USEPA and approved by USEPA on September 25, 2014.

The HHRA will assess potential current and future health risks associated with concentrations of constituents in soil, sediment, surface water, fish, and wildlife to which people that live near and/or work or recreate on the Site may potentially be exposed. This letter describes the data, constituents of potential concern (COPCs), toxicity assumptions, and potential exposure scenarios and exposure assumptions that will be used in the HHRA to evaluate the potential risks associated with the present and potential future uses of the Site. This Work Plan is comprised largely of information that has already been developed with the U.S. Environmental Protection Agency (USEPA) review and direction during the scoping process. This includes the specific receptors to be evaluated, exposure factors, and use of Thiessen polygons for developing exposure point concentrations. The Work Plan includes this previously developed information for completeness, but also includes additional discussion of the Conceptual Site Model that supports the risk assessment, the specific data screening and selection of COPCs to be evaluated in the HHRA, and the risk calculation formulae.

Conceptual Site Model

Wood-treating operations occurred at the Site from 1902 until 1991. Operations included treatment of railroad ties, utility poles, and other wood products using a

variety of wood-treating processes such as creosote, pentachlorophenol, chromated zinc chloride, and other preservatives. The Site is not currently used for commercial purposes, and activities are primarily limited to operation and maintenance of the completed remedy components, such as mowing, maintenance of the Corrective Action Management Unit (CAMU) containment cell, recovery of product at collection points, and periodic groundwater monitoring. Portions along the southern and western property boundaries are fenced to deter access to the Site. Anticipated future plans include development of a solar energy farm on a portion of the Site. The future development may also include a bike path along or near the southern boundary of the Site to connect separate bike paths being planned by the City of Carbondale and to potentially provide access to the Green Earth, Inc. Pyles Fork Preserve to the south of the Site. Additionally, it is currently anticipated that the City of Carbondale will hold a conservation easement for the majority of the Site not planned for solar development. While current access to the Site is limited, future exposure will assume recreational use for portions of the Site due to the potential bike path construction and trespasser exposure to portions of the Site outside the solar development.

Because concentrations of COPCs have been detected in certain areas beyond the property boundary, potential exposure of both on-Site and certain off-Site receptors will be estimated in the HHRA. The HHRA will reference USEPA's letter dated March 14, 2014 detailing the evidence demonstrating an incomplete exposure pathway for the neighborhood to the south of the Site. Therefore, exposure in the neighborhood to the south of the Site will not be evaluated in the HHRA. Examples of the off-Site receptors considered to have potentially complete pathways include residents to the north of the Site potentially contacting Smith Ditch and Glade Creek sediments and associated flood plain soils in the immediate vicinity of the creeks, kayakers/ canoeists and anglers who recreate along Piles Fork and Crab Orchard Creek downstream of the Site, and families that may consume deer that had foraged on the Site. All of the potentially complete pathways to be considered in the HHRA, as well as others determined in coordination with USEPA to be either incomplete or insignificant, are presented in Table 1.

For the purposes of the HHRA, the Site is divided into multiple "Exposure Areas" (Figure 1). These exposure areas were developed during prior investigations and evaluations for the Site, and generally divide the Site into areas of current/future use. The various on-Site and off-Site exposure areas and bases for them are summarized below.

- Eastern Conservation Exposure Area – Represents the eastern portion of the Site, including floodplain areas, that is primarily undeveloped and/or overgrown, and where conservation land use is anticipated.
- Southern Conservation Exposure Area – Represents the semi-wooded portion of the Site between the proposed solar area and the residential area located to the south of the Site. This is also potentially representative of where a bike path may be constructed as part of the redevelopment activities.
- Proposed Solar Use Area – Represents the portion of the Site where solar panels are currently envisioned in support of a 20 MW solar array. This is the area where solar-related construction and operational activities would occur, and that would be fenced to preclude access.
- Central Conservation Exposure Area – Represents the central portion of the Site where conservation land use is anticipated outside the portion of the Site where solar use is proposed.
- Western Conservation Exposure Area – Represents the portion of the facility property located west of North Marion Street; which was not part of historical wood-treating operations and where future conservation land use is anticipated.

In support of this Work Plan, additional off-Site areas were defined where potential risks will be evaluated for one or more receptor scenarios. These include:

- North and West of the Site – Includes the areas of Glade Creek and Smith Ditch, and floodplain soils in the immediate vicinity of the creeks that are located to the north and west of the Site. This area extends upstream to the point where Glade Creek crosses the railroad tracks immediately west of the Site and downstream to the point where Glade Creek reaches the Site property.
- East of the Site – Represents the small portion of Glade Creek and its floodplain that lays beyond the property boundary to the east of the Site, as well as the downstream portions of Piles Fork and Crab Orchard Creek.
- Railroad Property – Represents the area immediately to the south of the Site that includes the former railroad bed.
- 35’ Swath – Includes a thirty-five foot swath of land, owned by Beazer East, Inc, to the south of the railroad property also.

Summary of Data used in the HHRA and COPC Selection

Multiple remedial activities occurred at the Site so that some of the historical soil and sediment data do not reflect current conditions at the Site. Consequently, to characterize current conditions at the Site, the data supporting the HHRA include soil, sediment, surface water, and fish data collected in 2005 or later. Groundwater data were not evaluated in the screening because groundwater exposure is not anticipated under any receptor scenarios. All constituents that are detected in at least one sample collected at the Site will be included in the COPC screening.

Identification of COPCs

Maximum detected soil and sediment concentrations were conservatively screened against the regional screening levels (RSLs) (USEPA 2014a) or against USEPA's dioxin PRG (http://www.epa.gov/superfund/health/contaminants/dioxin/dioxinsoil.html) for 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents (TCDD TEQ). For potential on-Site soil exposures commercial/industrial RSLs/PRG were used. For potential on-Site sediment exposures commercial/industrial RSLs/PRG were adjusted for an exposure frequency of 16 days per year, which is a conservative estimate of potential exposure to sediments.

For all off-Site soils, residential RSLs/PRG were used for screening. Off-Site sediments along Smith Ditch and Glade Creek to the west and north of the Site were screened separately from off-Site sediments along Piles Fork and Crab Orchard Creek to the east of the Site because land use differs and associated receptors differ. The HHRA assumes Piles Fork and Crab Orchard Creek can support fishing and kayaking. To the west and north the creeks are too small to support such recreational activity but do pass near residential properties and, thus, direct contact exposures are possible. For off-Site sediments, residential RSLs/PRG were modified to reflect a 16 day per year exposure frequency and used for COPC screening.

If maximum concentrations of a constituent in soil and sediment are below the RSLs/PRG, that constituent will not be included as a COPC and will not be retained in the HHRA. Carcinogenic PAHs are presented as benzo(a)pyrene toxic equivalents (BaP-TE). Similarly, dioxins and furans are presented as TCDD TEQ. For surface water and fish concentrations, which do not have RSLs, all detected constituents were retained as COPCs in the HHRA. Tables 2 through 11 present the COPC screening for on-Site soil, on-Site sediment, off-Site soil, off-Site sediment, surface water, and fish, respectively.

The table below summarizes the COPCs based on the screening evaluations presented in Tables 2 through 11.

Area/Media	COPCs Retained
On-Site Soil	Fluoranthene, Naphthalene, Pentachlorophenol, Pyrene, BaP-TE, Arsenic, Chromium, and TCDD-TEQ
On-Site Sediment	BaP-TE and Arsenic
Off-Site Soil Railroad Property	Fluoranthene, Naphthalene, Pentachlorophenol, Pyrene, BaP-TE, Arsenic, Chromium, and TCDD-TEQ
Off-Site Soil 35' Swath	BaP-TE, Arsenic, Chromium, and TCDD TEQ
Off-Site Soil North and West	BaP-TE, Arsenic, and Chromium
Off-Site Sediment North and West	BaP-TE, Arsenic, and Chromium
Off-Site Soil East	BaP-TE, Arsenic, Chromium, and TCDD TEQ
Off-Site Sediment East	BaP-TE, Arsenic and Chromium
Surface Water	Pentachlorophenol, Acenaphthene, Anthracene, Fluoranthene, Fluorene, Pyrene, Arsenic, Chromium, and Copper
Fish	Acenaphthene, Anthracene, Fluoranthene, Fluorene, Phenol, BaP-TE, Arsenic, Chromium, Copper, and TCDD-TEQ

Exposure Assessment

Receptors

Reasonable Maximum Exposure (RME) scenarios have been developed for all receptors included in the HHRA. The receptors and their exposure assumptions were previously developed in coordination with USEPA and are presented in Table 12.[1]

[1] Most exposure assumptions have been previously presented to USEPA with the exception of two scenarios. Potential exposure to COPCs via consumption of deer meat was previously discussed with USEPA; however exposure assumptions were not reviewed with USEPA prior to submission of this Work Plan. Similarly, potential exposures associated with the railroad property and the 35' swath to the south of the Site and the portion of Glade Creek and Smith Ditch, and floodplain soils in the immediate vicinity of the creeks, north and west of the Site were previously discussed with USEPA but not included in prior versions of the exposure assumption table.

Attachment 1 details the estimation of deer meat ingestion rate presented in Table 12.

Estimation of COPC Intake

The Chronic Daily Intake (CDI) will be calculated to estimate a receptor's potential daily intake from exposure to COPCs in the media of interest. The equations used to estimate CDIs are presented below. The exposure parameters used in each potential exposure pathway are presented in Table 12.

Soil and Sediment

Exposure to soil will be assumed to occur via incidental ingestion, dermal contact, and inhalation of dust. Because sediment is not likely to produce dust, only the ingestion and dermal contact pathways will be evaluated for sediment. CDIs for soil and sediment ingestion will be calculated as follows:

$$CDI = \frac{CS \times IR \times ABSo \times FI \times EF \times ED \times CF}{AT \times BW}$$

where:

CDI	=	Chronic Daily Intake Due to Ingestion (mg/kg-day);
CS	=	Chemical Concentration in Soil or Sediment (mg/kg);
IR	=	Ingestion Rate of Soil or Sediment (mg/day);
ABSo	=	Oral Absorption Factor (unitless);
FI	=	Fraction Ingested (unitless);
EF	=	Exposure Frequency (days/year);
ED	=	Exposure Duration (years);
CF	=	Conversion Factor (10^{-6} kg/mg);
BW	=	Body Weight (kg); and
AT	=	Averaging Time (days).

CDIs for dermal absorption of soil and sediment will be calculated as follows:

$$CDI = \frac{CS \times CF \times AF \times ABSd \times EF \times ED \times SA}{AT \times BW}$$

where:

CDI	=	Chronic Daily Intake Due to Dermal Contact (mg/kg-day);
CS	=	Chemical Concentration in Soil and Sediment (mg/kg);
CF	=	Conversion Factor (10^{-6} kg/mg);
AF	=	Soil-to-Skin Adherence Factor (mg/cm^2);
ABS_d	=	Dermal Absorption Factor (unitless);
EF	=	Exposure Frequency (days/year);
ED	=	Exposure Duration (years);
SA	=	Skin Surface Area Available for Contact (cm^2/day);
BW	=	Body weight (kg); and
AT	=	Averaging time (days).

CDIs for the inhalation of dust from soil will be calculated as follows:

$$CDI = \frac{CS \times (1/PEF + 1/VF) \times CF_1 \times ET \times EF \times ED}{AT}$$

where:

CDI	=	Chronic Daily Intake Due to Dust Inhalation (ug/m^3);
CS	=	Chemical Concentration in Soil (mg/kg);
PEF	=	Particulate Emissions Factor (m^3/kg);
VF	=	Volatilization Factor (m^3/kg);
CF_1	=	Conversion factor (1000 ug/mg);
ET	=	Exposure time (hours/day);
EF	=	Exposure frequency (days/year);
ED	=	Exposure duration (years); and
AT	=	Averaging time (hours).

Surface Water

Exposure to surface water will be assumed to occur via incidental ingestion and dermal contact. CDIs for surface water ingestion will be calculated as follows:

$$CDI = \frac{C_{SW} \times IR \times ET \times EF \times ED \times CF}{AT \times BW}$$

where:

CDI	=	Chronic Daily Intake Due to Ingestion (mg/kg-day);
C_{SW}	=	Chemical Concentration in Surface Water (ug/L);
IR	=	Ingestion Rate of Surface Water (L/hour);
ET	=	Exposure Time (hours/day);
EF	=	Exposure Frequency (days/year);
ED	=	Exposure Duration (years);
CF	=	Conversion Factor (10^{-3} mg/ug);
BW	=	Body Weight (kg); and
AT	=	Averaging Time (days).

CDIs for dermal absorption of surface water will be calculated as follows:

$$CDI = \frac{DA_{event} \times EV \times ED \times EF \times SA}{AT \times BW}$$

where:

CDI	=	Chronic Daily Intake Due to Dermal Contact (mg/kg-day);
DA_{event}	=	Absorbed Dose (mg/cm^2-event);
EV	=	Event Frequency (events/day);
EF	=	Exposure Frequency (days/year);
ED	=	Exposure Duration (years);
SA	=	Skin Surface Area Available for Contact (cm^2);
BW	=	Body weight (kg); and
AT	=	Averaging time (days).

DA_{event} water will be calculated as follows:

If $t_{event} \leq t^*$, then:

$$DA_{event} = 2FA \times K_p \times C_{SW} \times CF \times \sqrt{\frac{6T \times t_{event}}{\Pi}}$$

If $t_{event} > t^*$, then:

$$DA_{event} = FA \times K_p \times C_{SW} \times CF \times \left[\frac{t_{event}}{1+B} + 2T_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where:

DA_{event}	=	Absorbed Dose (mg/cm^2-event);
FA	=	Fraction Absorbed of Water (unitless);
K_p	=	Dermal Permeability Coefficient of Compound in Water (cm/hour);
C_{SW}	=	Chemical Concentration in Surface Water (ug/L);
CF	=	Conversion Factor (1000 cm^3/L x 10^{-3} mg/ug);
T_{event}	=	Lag Time per Event (hours/event);
t_{event}	=	Event Duration (hours/event);
t*	=	Time to Reach Steady-State (hours) = 2.4 T_{event}; and
B	=	Dimensionless Ratio of the Permeability Coefficient of a Compound through the \Stratum Corneum Relative to its Permeability Coefficient Across the Epidermis (unitless).

Fish and Deer

Exposure to fish and deer tissue will be assumed to occur via ingestion. CDIs for fish and deer ingestion will be calculated as follows:

$$CDI = \frac{C \times IR \times EF \times ED}{AT \times BW}$$

where:

CDI	=	Chronic Daily Intake Due to Ingestion (mg/kg-day);
C	=	Chemical Concentration in Fish or Deer (mg/kg dry weight);
IR	=	Ingestion Rate of Fish or Deer (mg/day wet weight);
EF	=	Exposure Frequency (days/year);
ED	=	Exposure Duration (years);
BW	=	Body Weight (kg); and
AT	=	Averaging Time (days).

COPC concentrations in the plants in a deer's diet will be calculated as follows:

$$C_{plant} = C_{soil} \times Br$$

where:

C_{plant}	=	Chemical Concentration in Plants Due to Root Uptake (mg/kg dry weight);
C_{soil}	=	Chemical Concentration in Soil (mg/kg); and
Br	=	Plant-Soil Bioconcentration Factor (unitless).

COPC concentrations in deer meat will be calculated as follows:

$$C_{deer} = ((F \times Q_{plant} \times C_{plant}) + Q_{soil} \times C_{soil} \times B_{soil}) \times Ba_{deer}$$

where:

C_{deer}	=	Chemical Concentration in Deer (mg/kg dry weight);
F	=	Fraction of Plant Grown on Site Soil and Ingested by the Deer (unitless);
Q_{plant}	=	Quantity of Plant Ingested by the Deer per Day (kg DW/d);
C_{plant}	=	Chemical Concentration in Plants (mg/kg dry weight);
Q_{soil}	=	Quantity of Soil Ingested by the Deer per Day (kg DW/d);
C_{soil}	=	Chemical Concentration in Soil (mg/kg);
B_{soil}	=	Soil Bioavailability Factor (unitless); and
Ba_{deer}	=	Biotransfer Factor for Deer (beef used as a surrogate) (mg/kg fresh weight).

The equation used to estimate COPC concentrations in the deer's diet and the subsequent equation to estimate COPC concentrations in deer meat are adapted from the *Human Health Risk Assessment Protocol (HHRAP) for Hazardous Waste Combustion Facilitie*s (USEPA 2005). Uptake into beef cattle was used as a surrogate for uptake into deer.

Determination of Exposure Point Concentrations

Exposure Point Concentrations (EPCs) for all COPCs in on-Site surface soil will be estimated using spatially-weighted 95th percentile upper confidence limits (UCLs) on the mean. Spatially-weighted 95th UCLs for each exposure area, including the overall site, were calculated using Thiessen polygons. Attachment 2 presents the application of Thiessen polygons that will be used in the HHRA.

Spatially-weighted 95th percentile UCLs will also be estimated for all COPCs in surface soil in the off-Site railroad property and 35' swath, for which Thiessen

polygons were developed assuming a “hard” boundary between the railroad property and the Site and assuming a “soft” boundary between the railroad property and the 35’ swath. Figures 2 through 9 present the Thiessen polygons for fluoranthene, naphthalene, pentachlorophenol, pyrene, BaP-TE, arsenic, chromium, and TCDD TEQ, respectively.

For other on-Site and off-Site media and exposure areas (i.e., on-Site sediment, off-Site soil to the north & west and east, off-Site sediments, off-Site surface water, and fish tissue), spatially defining the extent of the Thiessen polygons becomes arbitrary, therefore, ProUCL 5.0 (USEPA 2013) will be used to develop 95th percentile UCLs. Spatially-weighted EPCs are not ideal in this instance and the use of ProUCL to develop EPCs for these media is appropriate.

Toxicity Assessment

The toxicity values used in the HHRA will be obtained from the following sources, in order of priority, per USEPA guidance (USEPA 2003):

- Tier 1 – USEPA’s Integrated Risk Information System (IRIS) (USEPA 2014b);
- Tier 2 – USEPA’s Provisional Peer Review Toxicity Values; and
- Tier 3 – Other toxicity values including those from additional USEPA and non-USEPA sources such as the EPA’s Health Effects Assessment Summary Tables (HEAST), and values developed by the Agency for Toxic Substances and Disease Registry (ATSDR) and the California Environmental Protection Agency (CalEPA).

The future on-Site solar farm redevelopment worker scenario, current/future on-Site child deer consumer scenario, and current/future off-Site child recreational angler scenario were assumed to be subchronic exposures and, thus, used the subchronic non-cancer toxicity values. All other scenarios were assumed to potentially be chronic exposures. Tables 13 through 18 present the subchronic, chronic, and cancer-based toxicity values that will be used in the HHRA.

Risk Characterization

The potential for exposures to COPCs in media on-Site and off-Site to result in potential adverse non-carcinogenic health effects will be estimated by comparing the CDI for each COPC with a reference dose (RfD) for that COPC, or in the case of the inhalation pathway, comparing the CDI for each COPC with a reference

concentration (RfC) for that COPC. The resulting ratio, which is unitless, is known as the hazard quotient (HQ) for that COPC.

When the HQ for a given COPC and pathway does not exceed 1, the RfD has not been exceeded, and no potential adverse non-carcinogenic health effects are expected to occur as a result of exposure to that COPC via that pathway. The HQs for each COPC are summed to yield the Hazard Index (HI) for that pathway. A total HI is then calculated for each exposure medium by summing the pathway-specific HIs. A total HI that does not exceed 1 indicates that no potential adverse non-carcinogenic health effects are expected to occur as a result of that receptor's potential exposure to COPCs in the environmental medium evaluated. This approach assumes that exposures to multiple chemicals are additive. However, HIs should only be summed for constituents with the same target organ or endpoint. Therefore, where the Total HI across all media exceeds 1, endpoint-specific HIs will be estimated and compared to the HI limit of 1. An endpoint-specific total HI that does not exceed 1 indicates that no potential adverse non-carcinogenic health effects are expected to occur as a result of that receptor's potential exposure to COPCs in the environmental medium evaluated.

The purpose of carcinogenic risk characterization is to estimate the potential likelihood, over and above the background cancer rate, that a receptor will develop cancer in his or her lifetime as a result of potential Site-related exposures to COPCs in various environmental media. This likelihood is a function of the dose of a COPC and the cancer slope factor (CSF) for that COPC or, in the case of the inhalation pathway, a function of the exposure to the COPC and the inhalation unit risk (IUR). The relationship between the Potential Excess Lifetime Cancer Risk (PELCR) and the estimated CDI of a COPC may be expressed by the following equation: .

$$PELCR = CSF\ (or\ IUR) \times CDI$$

where:

PELCR	=	Potential Excess Lifetime Cancer Risk (unitless);
CFS (or IUR)	=	Cancer Slope Factor (1/(mg/kg-day)) or Inhalation Unit Risk ($1/mg/m^3$); and
CDI	=	Chronic Daily Intake (mg/kg-day or ug/m^3).

Pathway PELCRs are calculated for each COPC with potentially carcinogenic effects. The PELCRs for each pathway by which the receptor is assumed to be exposed are calculated by summing the potential risks derived for each COPC. A

Total PELCR is then calculated for each exposure medium by summing the pathway-specific PELCRs.

In general, the USEPA considers excess cancer risks that are below about 1 chance in 1,000,000 (1×10^{-6} or 1E-06) to be so small as to be negligible, and risks above 1E-04 to be sufficiently large they warrant further evaluation. Excess cancer risk estimates that range between $1x10^{-6}$ and $1x10^{-4}$ are generally considered to be acceptable (USEPA 1991).

The conservative estimates of potential cancer and potential non-cancer risks for all receptors potentially exposed to the COPCs from the Site will be compared with USEPA's acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$ and target hazard index of 1 to determine whether the estimated potential current and potential future risks are within or below USEPA's target risk range.

Sincerely,

ARCADIS

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Tables

TABLE 1
SUMMARY OF EXPOSURE PATHWAYS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

Pathway	Pathway Status	Rationale
On-Site Receptor Populations		
Current/Future On-Site Adult Maintenance Worker/Caretaker	Complete	Though exposure potential is limited and may be insignificant because of training and PPE, will be evaluated quantitatively in the BHHRA at EPA's request assuming a Site-wide exposure area.
Current/Future On-site Adult Deer Hunter and Adolescent and Child Deer Consumer	Complete	One family currently has permission to hunt on-Site. This arrangement is limited to a small portion of the Site and has rarely been utilized. Additionally, much of the Site is within the City limit and discharge of firearms is not allowed within City limits per City ordinances. However, the BHHRA will conservatively assume this pathway is complete under the scenario that deer grazing at the Site could be harvested on another property.
Current/Future On-site Adult and Adolescent Recreational Crayfishers	Incomplete	Crayfish collection has not been observed on the Site nor has evidence of such collection been observed. Additionally, field crews targeted crayfish in both Piles Fork and Glade Creek but collected very few, indicating crayfish are not abundant at the Site.
Future On-site Adult and Adolescent Hikers/Bicycle Users	Complete	Will be evaluated quantitatively in the BHHRA for the southern exposure area.
Current/Future On-site Adolescent Trespasser	Complete	Will be evaluated quantitatively in the BHHRA assuming a Site-wide exposure area.
Future On-site Adult Generic Industrial Worker	Incomplete	Future use of the Site is solar and conservation. Institutional controls will preclude generic industrial development without further evaluation to confirm planned use meets allowable risk levels.
Future On-site Solar Farm Redevelopment Worker	Complete	Will be evaluated quantitatively in the BHHRA for the solar exposure area.
Future On-site Solar Farm Maintenance Worker	Complete	Will be evaluated quantitatively in the BHHRA for the solar exposure area.
Future On-site Generic Redevelopment Worker	Incomplete	Institutional Controls will establish protective controls, such as the need for a HASP and management plan to eliminate future exposure in the event of any redevelopment or intrusive work. Institutional controls will preclude generic industrial development without further evaluation to confirm planned use meets allowable risk levels.
Off-Site Receptor Populations		
Current/Future Off-site Adult and Child Residents	Incomplete	EPA's March 14, 2014 letter indicating the pattern of off-Site concentrations in the residential neighborhood to the south of the Site indicates that releases from the Site are not the source the measured concentrations.
Current/Future Off-site Adult and Adolescent Kayaker/Canoeist	Complete	Though exposure potential is limited and may be insignificant because of the nature of Crab Orchard Creek (COC) near the Site (i.e., steep banks and debris make it hard to access), will be evaluated quantitatively in the BHHRA at EPA's request assuming exposure to COC sediments and surface water.
Current/Future Off-site Adult and Adolescent Recreational Angler and Child Fish Consumer	Complete	Though exposure potential is limited and may be insignificant because of the nature of COC near the Site (i.e., steep banks and debris make it hard to access, few deep pools to harbor fish), will be evaluated quantitatively in the BHHRA assuming direct exposure to COC sediments and surface water and consumption of fish from COC.
Current/Future Adolescent Trespasser	Complete	Will be evaluated quantitatively in the BHHRA assuming exposure to soil in the railroad property, 35' swath soils, sediments and soils adjacent to creeks to the north and west of the Site, and in the Glade Creek floodplain downstream of the property boundary.
Hypothetical Future Adult and Adolescent Hikers/Bicycle Users in Railroad Property	Complete	Although permission has not been granted to utilize the railroad property for the future bike path, hypothetical hikers/bicycle users will conservatively be assumed to be exposed to the railroad property in the future.

TABLE 2
ON-SITE SOIL COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
83-32-9	Acenaphthene	123/163	123	163	75.5	1.3	1100000	SDD-7-TLB	8.5	18000	9800	4500000	no	BSL
208-96-8	Acenaphthylene	154/163	154	163	94.5	3.6	81000	SDD-7-TLB	8.5	92	3640	NA	no	NTX
120-12-7	Anthracene	156/163	156	163	95.7	3.1	500000	SDD-7-TLB	8.5	9.4	9510	23000000	no	BSL
191-24-2	Benzo(ghi)perylene	154/163	154	163	94.5	3.3	220000	SDD-7-TLB	8.5	360	8380	NA	no	NTX
86-74-8	Carbazole	1/1	1	1	100	1300	1300	SDD-16			1300	NA	no	NTX
206-44-0	Fluoranthene	157/163	157	163	96.3	1.7	4900000	SDD-7-TLB	8.5	92	46500	3000000	yes	ASL
86-73-7	Fluorene	137/163	137	163	84.0	1.6	670000	SDD-7-TLB	8.7	2700	7030	3000000	no	BSL
91-20-3	Naphthalene	141/163	141	163	86.5	1.4	680000	SDD-7-TLB	8.5	1900	7340	17000	yes	ASL
87-86-5	Pentachlorophenol	84/109	84	109	77.1	10	190000	SDD-16	43	88000	15800	4000	yes	ASL
85-01-8	Phenanthrene	162/163	162	163	99.4	2.7	1800000	SDD-7-TLB	360	360	21100	NA	no	NTX
108-95-2	Phenol	1/5	1	5	20.0	46	46	GC-BC-FPT3-5R	8.8	98	25.1	25000000	no	BSL
129-00-0	Pyrene	157/163	157	163	96.3	4.4	2500000	SDD-7-TLB	8.5	9.4	28700	2300000	yes	ASL
50-32-8	BAP TE (NDs = 1/2 DL)	163/163	163	163	100	7.37	699000	SDD-7-TLB			16700	290	yes	ASL
	Metals													
7440-38-2	Arsenic	142/142	142	142	100	1100	63800	A2-15			14500	3000	yes	ASL
7440-47-3	Chromium	55/55	55	55	100	12900	155000	A2-16			30600	6300	yes	ASL
7440-50-8	Copper	55/55	55	55	100	9500	55400	A2-13(3/29/2010)			23500	4700000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	103/103	103	103	100	0.00299	35.6	A3-14			2.75	0.664	yes	ASL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 3
ON-SITE SEDIMENT COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
83-32-9	Acenaphthene	9/15	9	15	60.0	14	2700	GC-BC-10	0.00925	71	257	70000000	no	BSL
208-96-8	Acenaphthylene	13/15	13	15	86.7	0.058	4600	A5-7	0.00925	53	1020	NA	no	NTX
120-12-7	Anthracene	13/15	13	15	86.7	0.069	5600	A5-7	0.00925	53	1310	360000000	no	BSL
191-24-2	Benzo(ghi)perylene	13/15	13	15	86.7	0.11	8600	A5-7	0.00925	53	1990	NA	no	NTX
206-44-0	Fluoranthene	13/15	13	15	86.7	0.11	22000	GC-BC-10	0.00925	53	2420	47000000	no	BSL
86-73-7	Fluorene	11/15	11	15	73.3	0.013	3100	GC-BC-10	0.00925	53	336	47000000	no	BSL
91-20-3	Naphthalene	7/15	7	15	46.7	35	680	A5-7	0.00925	72	115	270000	no	BSL
87-86-5	Pentachlorophenol	12/15	12	15	80.0	0.09	2100	A5-7	0.0455	260	513	63000	no	BSL
85-01-8	Phenanthrene	15/15	15	15	100	0.0065	16000	GC-BC-10			1410	NA	no	NTX
129-00-0	Pyrene	13/15	13	15	86.7	0.078	13000	GC-BC-10	0.00925	53	1670	36000000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	13/13	13	13	100	67.45	9480	A5-7			3250	4500	yes	ASL
	Metals													
7440-38-2	Arsenic	15/15	15	15	100	5.3	71500	GC-BC-09			12300	47000	yes	ASL
7440-47-3	Chromium	15/15	15	15	100	17.95	27000	GC-BC-09			17400	98000	no	BSL
7440-50-8	Copper	15/15	15	15	100	17.7	26800	A5-7			18600	73000000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	6/6	6	6	100	0.037	0.688	SD-BC-01			0.316	13.8	no	BSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 4
OFF-SITE SOIL RAILROAD PROPERTY COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Units	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs														
83-32-9	Acenaphthene	ug/kg	22/32	22	32	68.8	2.2	300000	SB-119	0.64	19	9450	350000	no	BSL
208-96-8	Acenaphthylene	ug/kg	31/32	31	32	96.9	2.8	50000	SB-119	8.9	8.9	2420	NA	no	NTX
120-12-7	Anthracene	ug/kg	32/32	32	32	100	2.5	840000	SB-119			27300	1700000	no	BSL
191-24-2	Benzo(ghi)perylene	ug/kg	31/32	31	32	96.9	6	47000	SB-119	8.5	8.5	3330	NA	no	NTX
206-44-0	Fluoranthene	ug/kg	32/32	32	32	100	5.35	4300000	SB-119			141000	230000	yes	ASL
86-73-7	Fluorene	ug/kg	24/32	24	32	75.0	2.4	140000	SB-119	0.64	280	4450	230000	no	BSL
91-20-3	Naphthalene	ug/kg	30/32	30	32	93.8	2.5	46000	SB-119	8.5	8.8	1780	3800	yes	ASL
87-86-5	Pentachlorophenol	ug/kg	12/27	12	27	44.4	17.5	8000	A1-37	42	870000	17100	990	yes	ASL
85-01-8	Phenanthrene	ug/kg	32/32	32	32	100	6.45	2800000	SB-119			89200	NA	no	NTX
129-00-0	Pyrene	ug/kg	32/32	32	32	100	5.65	2900000	SB-119			95500	170000	yes	ASL
50-32-8	BAP TE (NDs = 1/2 DL)	ug/kg	30/30	30	30	100	9.75	275000	SB-119			13800	15	yes	ASL
	Metals														
7440-38-2	Arsenic	ug/kg	22/22	22	22	100	3400	36400	A1-11			11100	670	yes	ASL
7440-47-3	Chromium	ug/kg	12/12	12	12	100	11900	20700	A1-45			17500	300	yes	ASL
7440-50-8	Copper	ug/kg	12/12	12	12	100	12500	40100	A1-40			21000	310000	no	BSL
	Dioxins/Furans														
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	ug/kg	24/24	24	24	100	0.00431	7.605	A1-1(12/9/2009)			0.962	0.05	yes	ASL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 5
OFF-SITE SOIL 35' SWATH COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Units	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs														
83-32-9	Acenaphthene	ug/kg	5/8	5	8	62.5	5.3	900	A1-41	9.2	19	134	350000	no	BSL
208-96-8	Acenaphthylene	ug/kg	8/8	8	8	100	2.8	2600	SB-115			514	NA	no	NTX
120-12-7	Anthracene	ug/kg	8/8	8	8	100	3.4	3100	SB-115			847	1700000	no	BSL
191-24-2	Benzo(ghi)perylene	ug/kg	8/8	8	8	100	6	4800	A1-41			1550	NA	no	NTX
206-44-0	Fluoranthene	ug/kg	8/8	8	8	100	19	25000	A1-41			5590	230000	no	BSL
86-73-7	Fluorene	ug/kg	6/8	6	8	75.0	3	520	A1-41	9.2	9.4	91.6	230000	no	BSL
91-20-3	Naphthalene	ug/kg	8/8	8	8	100	2.5	3600	SB-115			544	3800	no	BSL
87-86-5	Pentachlorophenol	ug/kg	3/8	3	8	37.5	30.5	3200	SB-115	46	790	568	990	yes	ASL
85-01-8	Phenanthrene	ug/kg	8/8	8	8	100	9.7	12000	A1-41			3010	NA	no	NTX
129-00-0	Pyrene	ug/kg	8/8	8	8	100	13	13000	A1-41			3660	170000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	ug/kg	7/7	7	7	100	15.5	9860	SB-115			3480	15	yes	ASL
	Metals														
7440-38-2	Arsenic	ug/kg	5/5	5	5	100	8500	12850	A1-44(3/30/2010)			10700	670	yes	ASL
7440-47-3	Chromium	ug/kg	4/4	4	4	100	16550	20700	A1-45			18500	300	yes	ASL
7440-50-8	Copper	ug/kg	4/4	4	4	100	12350	23400	A1-45			17700	310000	no	BSL
	Dioxins/Furans														
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	ug/kg	6/6	6	6	100	0.00431	7.605	A1-1(12/9/2009)			1.46	0.05	yes	ASL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 6
OFF-SITE SOIL NORTH AND WEST OF THE SITE COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
83-32-9	Acenaphthene	6/11	6	11	54.5	8.9	240	A4-5	8.4	10	33.3	350000	no	BSL
208-96-8	Acenaphthylene	9/11	9	11	81.8	3.2	580	A4-5	8.4	8.8	101	NA	no	NTX
120-12-7	Anthracene	10/11	10	11	90.9	1.3	860	A4-5	8.8	8.8	132	1700000	no	BSL
191-24-2	Benzo(ghi)perylene	9/11	9	11	81.8	12	1400	A4-5	8.4	8.8	253	NA	no	NTX
206-44-0	Fluoranthene	11/11	11	11	100	5.5	3200	A4-5			514	230000	no	BSL
86-73-7	Fluorene	5/11	5	11	45.5	6.3	230	A4-5	8.4	62	30.1	230000	no	BSL
91-20-3	Naphthalene	7/11	7	11	63.6	5.4	560	A4-5	8.4	10	86.1	3800	no	BSL
85-01-8	Phenanthrene	11/11	11	11	100	6.8	2500	A4-5			351	NA	no	NTX
129-00-0	Pyrene	11/11	11	11	100	3.8	1800	A4-5			305	170000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	11/11	11	11	100	8.38	1730	A4-5			368	15	yes	ASL
	Metals													
7440-38-2	Arsenic	11/11	11	11	100	6900	13000	A4-6			10000	670	yes	ASL
7440-47-3	Chromium	11/11	11	11	100	14700	28200	A4-6			19300	300	yes	ASL
7440-50-8	Copper	11/11	11	11	100	15300	128000	A4-5			35600	310000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	13/13	13	13	100	0.00232	0.0472	A4-6			0.0149	0.05	no	BSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 7
OFF-SITE SEDIMENT TO THE NORTH AND WEST OF THE SITE COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
83-32-9	Acenaphthene	13/14	13	14	92.9	8	1200	A6-3	40	40	187	7700000	no	BSL
208-96-8	Acenaphthylene	14/14	14	14	100	11	340	A6-3			127	NA	no	NTX
120-12-7	Anthracene	14/14	14	14	100	13	460	A6-3			193	37000000	no	BSL
191-24-2	Benzo(ghi)perylene	14/14	14	14	100	39	1400	GC-BC-03			462	NA	no	NTX
206-44-0	Fluoranthene	14/14	14	14	100	87	4600	GC-BC-03			992	5000000	no	BSL
86-73-7	Fluorene	12/14	12	14	85.7	7.9	990	A6-3	40	76	158	5000000	no	BSL
91-20-3	Naphthalene	9/14	9	14	64.3	8.1	2000	A6-3	40	86	252	83000	no	BSL
87-86-5	Pentachlorophenol	4/14	4	14	28.6	82	220	SD-BC-04	50	520	146	22000	no	BSL
85-01-8	Phenanthrene	14/14	14	14	100	37	2100	A6-3			519	NA	no	NTX
129-00-0	Pyrene	14/14	14	14	100	69	2600	GC-BC-03			639	3700000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	14/14	14	14	100	74.2	2600	GC-BC-03			727	330	yes	ASL
	Metals													
7440-38-2	Arsenic	14/14	14	14	100	6700	29200	GC-BC-06			11900	15000	yes	ASL
7440-47-3	Chromium	14/14	14	14	100	14600	60500	A4-1			22100	6600	yes	ASL
7440-50-8	Copper	14/14	14	14	100	12500	39200	GC-BC-04			25900	6800000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	9/9	9	9	100	0.00471	0.144	SD-BC-04			0.0358	1.46	no	BSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 8
OFF-SITE SOIL EAST OF THE SITE COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
83-32-9	Acenaphthene	6/8	6	8	75.0	3.2	7.3	GC-BC-FPT6-5R	8.7	9.1	4.47	350000	no	BSL
208-96-8	Acenaphthylene	8/8	8	8	100	10	67	GC-BC-FPT6-5L			31.4	NA	no	NTX
120-12-7	Anthracene	8/8	8	8	100	15	80	GC-BC-FPT6-5L			40.9	1700000	no	BSL
191-24-2	Benzo(ghi)perylene	8/8	8	8	100	48	200	GC-BC-FPT6-5L			115	NA	no	NTX
206-44-0	Fluoranthene	8/8	8	8	100	21	160	GC-BC-FPT6-33%R			77.6	230000	no	BSL
86-73-7	Fluorene	8/8	8	8	100	3.7	14	GC-BC-FPT6-5R			8.46	230000	no	BSL
91-20-3	Naphthalene	8/8	8	8	100	3.1	9.4	GC-BC-FPT6-5R			6.04	3800	no	BSL
87-86-5	Pentachlorophenol	4/4	4	4	100	7.2	52	GC-BC-FPT6-33%L			19.0	990	no	BSL
85-01-8	Phenanthrene	8/8	8	8	100	13	53	GC-BC-FPT6-33%R			31.6	NA	no	NTX
129-00-0	Pyrene	8/8	8	8	100	22	160	GC-BC-FPT6-33%R			80.0	170000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	8/8	8	8	100	65.6	236	GC-BC-FPT6-5L			166	15	yes	ASL
	Metals													
7440-38-2	Arsenic	8/8	8	8	100	6300	9400	GC-BC-FPT6-33%L			7530	670	yes	ASL
7440-47-3	Chromium	8/8	8	8	100	15800	27400	GC-BC-FPT6-33%R			20000	300	yes	ASL
7440-50-8	Copper	8/8	8	8	100	16000	27600	GC-BC-FPT6-33%R			20500	310000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	4/4	4	4	100	0.0132	0.165	GC-BC-FPT6-5L			0.0590	0.05	yes	ASL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 9
OFF-SITE SEDIMENT EAST OF THE SITE COPC SCREENING
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/kg	Maximum Detect ug/kg	Max Detect Location	Minimum Non-Detect ug/kg	Maximum Non-Detect ug/kg	Arithmetic Average ug/kg	Screening Concentration ug/kg	COPC?	Rationale
	SVOCs													
90-12-0	1-Methylnaphthalene	4/4	4	4	100	22	1000	PF-BC-03-NAPL			288	370000	no	BSL
832-69-9	1-Methylphenanthrene	4/4	4	4	100	19	1500	PF-BC-03-NAPL			417	NA	no	NTX
2245-38-7	2,3,5-Trimethylnaphthalene	4/4	4	4	100	14	460	PF-BC-03-NAPL			132	NA	no	NTX
28804-88-8	2,6-Dimethylnaphthalene	4/4	4	4	100	13	890	PF-BC-03-NAPL			248	NA	no	NTX
91-57-6	2-Methylnaphthalene	4/4	4	4	100	14	560	PF-BC-03-NAPL			158	500000	no	BSL
83-32-9	Acenaphthene	17/19	17	19	89.5	20	79000	COC-BC-04-DEL	55.5	83	4760	7700000	no	BSL
208-96-8	Acenaphthylene	19/19	19	19	100	3.8	5700	COC-BC-04-DEL			410	NA	no	NTX
120-12-7	Anthracene	19/19	19	19	100	5.2	54000	COC-BC-04-DEL			3330	37000000	no	BSL
192-97-2	Benzo(e)pyrene	4/4	4	4	100	150	2100	PF-BC-03-NAPL			660	NA	no	NTX
191-24-2	Benzo(ghi)perylene	19/19	19	19	100	15	8100	COC-BC-04-DEL			907	NA	no	NTX
92-52-4	Biphenyl	3/4	3	4	75.0	1.4	2.35	COC-BC-04(7/15/2010)	50	50	7.59	100000	no	BSL
132-65-0	Dibenzothiophene	4/4	4	4	100	12	1000	PF-BC-03-NAPL			284	1700000	no	BSL
206-44-0	Fluoranthene	19/19	19	19	100	15	250000	COC-BC-04-DEL			16100	5000000	no	BSL
86-73-7	Fluorene	19/19	19	19	100	20	78000	COC-BC-04-DEL			4710	5000000	no	BSL
91-20-3	Naphthalene	15/19	15	19	78.9	5.4	4500	COC-BC-04-DEL	55.5	1000	327	83000	no	BSL
87-86-5	Pentachlorophenol	3/19	3	19	15.8	97	150	PF-BC-03-NAPL	47	29000	897	22000	no	BSL
198-55-0	Perylene	4/4	4	4	100	57	490	PF-BC-03-NAPL			173	NA	no	NTX
85-01-8	Phenanthrene	19/19	19	19	100	27	280000	COC-BC-04-DEL			17700	NA	no	NTX
129-00-0	Pyrene	19/19	19	19	100	21	150000	COC-BC-04-DEL			10000	3700000	no	BSL
50-32-8	BAP TE (NDs = 1/2 DL)	13/13	13	13	100	30.4	37300	COC-BC-04-DEL			4050	330	yes	ASL
	Metals													
7440-38-2	Arsenic	19/19	19	19	100	5950	16600	COC-BC-07			8900	15000	yes	ASL
7440-47-3	Chromium	19/19	19	19	100	12600	22500	COC-BC-04-DEL,GC-BC-16			15700	6600	yes	ASL
7440-50-8	Copper	19/19	19	19	100	12400	23500	GC-BC-16			15900	6800000	no	BSL
	Dioxins/Furans													
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	16/16	16	16	100	0.00247	0.055	GC-BC-16			0.0177	1.46	no	BSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NA = not available
BSL = below screening level
ASL = above screening level
NTX = no toxicity data

TABLE 10
SURFACE WATER COPCS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect ug/L	Maximum Detect ug/L	Max Detect Location	Minimum Non-Detect ug/L	Maximum Non-Detect ug/L	Arithmetic Average ug/L	COPC?	Rationale
	SVOCs												
87-86-5	Pentachlorophenol	1/4	1	4	25	0.76	0.76	GC-BC-05	0.94	1.1	0.568	yes	NSL
83-32-9	Acenaphthene	3/4	3	4	75	0.18	0.24	GC-BC-10	0.2	0.2	0.185	yes	NSL
208-96-8	Acenaphthylene	1/4	1	4	25	0.15	0.15	GC-BC-05	0.19	0.21	0.113	no	NTX
120-12-7	Anthracene	4/4	4	4	100	0.22	0.27	GC-BC-05			0.235	yes	NSL
206-44-0	Fluoranthene	3/4	3	4	75	0.335	0.38	GC-BC-05	0.2	0.2	0.296	yes	NSL
86-73-7	Fluorene	2/4	2	4	50	0.365	0.44	GC-BC-05	0.2	0.21	0.253	yes	NSL
85-01-8	Phenanthrene	4/4	4	4	100	0.23	0.37	GC-BC-05			0.290	yes	NTX
129-00-0	Pyrene	3/4	3	4	75	0.0675	0.074	GC-BC-05	0.2	0.2	0.0781	yes	NSL
	Metals												
7440-38-2	Arsenic	4/4	4	4	100	2.6	4.1	GC-BC-05			3.09	yes	NSL
7440-47-3	Chromium	3/4	3	4	75	1.3	1.8	GC-BC-05,GC-BC-08	5	5	1.85	yes	NSL
7440-50-8	Copper	4/4	4	4	100	1.4	2.9	GC-BC-08			2.40	yes	NSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NSL = no screening level
NTX = no toxicity data

TABLE 11
FISH COPCS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS	Parameter	Detection Frequency	Detect Count	Result Count	Detection Frequency (%)	Minimum Detect mg/kg	Maximum Detect mg/kg	Max Detect Location	Minimum Non-Detect mg/kg	Maximum Non-Detect mg/kg	Arithmetic Average mg/kg	COPC?	Rationale
	SVOCs												
83-32-9	Acenaphthene	3/3	3	3	100	0.0047	0.022	COC-BC-07-EDCAT			0.0152	yes	NSL
208-96-8	Acenaphthylene	2/3	2	3	66.7	0.00092	0.0018	COC-BC-07-EDCAT	0.00069	0.00069	0.00102	no	NTX
120-12-7	Anthracene	3/3	3	3	100	0.0016	0.0077	COC-BC-07-EDCAT			0.00477	yes	NSL
191-24-2	Benzo(ghi)perylene	1/3	1	3	33.3	0.0025	0.0025	COC-BC-07-EDCAT	0.0007	0.00073	0.00107	no	NTX
206-44-0	Fluoranthene	3/3	3	3	100	0.006	0.02	COC-BC-07-EDCAT			0.015	yes	NSL
86-73-7	Fluorene	3/3	3	3	100	0.0032	0.015	COC-BC-07-EDCAT			0.00973	yes	NSL
85-01-8	Phenanthrene	3/3	3	3	100	0.0064	0.024	COC-BC-07-EDCAT			0.0155	no	NTX
108-95-2	Phenol	3/3	3	3	100	0.0019	0.0081	COC-BC-07-EDCAT			0.00543	yes	NSL
129-0-00	Pyrene	3/3	3	3	100	0.028865	0.1245	COC-BC-07-EDCAT			0.0784	yes	NSL
50-32-8	BAP TE (NDs = 1/2 DL)	1/3	1	3	33.3	0.0053	0.0053	COC-BC-07-EDCAT	0.0015	0.0015	0.00228	yes	NSL
	Metals												
7440-38-2	Arsenic	3/3	3	3	100	0.06	0.17958	COC-BC-07-EDCAT			0.139	yes	NSL
7440-47-3	Chromium	1/3	1	3	33.3	0.03	0.03	COC-BC-04-EDCAT	0.01449	0.01533	0.015	yes	NSL
7440-50-8	Copper	3/3	3	3	100	0.24	0.42924	COC-BC-07-EDCAT			0.325	yes	NSL
	Dioxins/Furans												
1746-01-6	TCDD TEQ (NDs = 1/2 DL)	3/3	3	3	100	1.60E-07	3.10E-07	COC-BC-07-EDCAT			2.11E-07	yes	NSL

ug/kg = microgram per kilogram
COPC = constituent of potential concern
SVOCs = semi-volatile organic compounds
NDs = non-detects
DL = detection limit
BaP TE = benzo(a)pyrene toxic equivalents
TCDD TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents
NSL = no screening level
NTX = no toxicity data

TABLE 12
HUMAN HEALTH EXPOSURE ASSUMPTIONS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

Parameter	Units	Current/Future On-Site Adult Maintenance Worker/Caretaker	Notes	Future On-site Solar Farm Redevelopment Worker	Notes	Future On-site Solar Farm Maintenance Worker	Notes	Current/Future Adolescent Trespasser	Notes	Current/Future On-site Adult Deer Hunter	Notes	Current/Future On-site Adolescent Deer Consumer	Notes
Exposure Areas		**On-Site**		**Proposed Solar Use Area**				**On-Site, Railroad Property, and 35' Swath**		**Entire Site**			
General													
Averaging Time (carcinogenic)	days	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991
Averaging Time (noncarcinogenic)	days	9125	ED x 365 days/year	365	ED x 365 days/year	9125	ED x 365 days/year	3650	ED x 365 days/year	10950	ED x 365 days/year	3650	ED x 365 days/year
Body Weight	kg	70	USEPA 2002	70	USEPA 2002	70	USEPA 2002	46.8	USEPA 2011; 6 - 16 yr age-adjusted body weight	70	USEPA 2002	46.8	USEPA 2011; 6 - 16 yr age-adjusted body weight
Exposure Duration	yr	25	USEPA 2002	1	Site-specific	25	USEPA 2002	10	Professional judgment	30	Professional judgment	10	Professional judgment
Soil - Ingestion													
Incidental Soil Ingestion Rate	mg/day	100	USEPA 2002	330	USEPA 2002	100	USEPA 2002	100	USEPA 2002	-		-	
Fraction of Total Soil Ingested	unitless	1	Professional judgment	1	Professional judgment	1	Professional judgment	1	Professional judgment	-		-	
Exposure Frequency	days/yr	125	Site-specific (Brightfields' experience) 2.5 days a week; 50 weeks/year	40	Site-specific (Brightfields' experience) 5 days a week; 2 months/year	75	Professional judgment, based on experience at solar facilities; 1.5 days a week; 50 weeks/year	16	Professional judgment; 1 day/week per year; 4 warm months per year	-		-	
Soil - Dermal Contact													
Exposed Skin Surface Area	cm^2	3300	USEPA 2002; head, hands, and forearms	3300	USEPA 2002; head, hands, and forearms	3300	USEPA 2002; head, hands, and forearms	4890	USEPA 2011; Lower legs, feet, forearms and hands	-		-	
Skin Adherence Factor	mg/cm^2-event	0.2	USEPA 2002	0.3	USEPA 2002	0.2	USEPA 2002	0.2	USEPA 2007; age-specific & body-part specific	-		-	
Exposure Frequency	days/yr	125	Site-specific (Brightfields' experience) 2.5 days a week; 50 weeks/year	40	Site-specific (Brightfields' experience) 5 days a week; 2 months/year	75	Professional judgment, based on experience at solar facilities; 1.5 days a week; 50 weeks/year	16	Professional judgment; 1 day/week per year; 4 warm months per year	-		-	
Fraction Intake	unitless	1	Professional judgment	1	Professional judgment	1	Professional judgment	1	Professional judgment	-		-	
Soil - Inhalation of Dust													
Exposure Time, Inhalation	hr/day	8	Professional judgment	8	Professional judgment	8	Professional judgment	2	Professional judgment	-		-	
Exposure Frequency	days/yr	125	Site-specific (Brightfields' experience) 2.5 days a week; 50 weeks/year	40	Site-specific (Brightfields' experience) 5 days a week; 2 months/year	75	Professional judgment, based on experience at solar facilities; 1.5 days a week; 50 weeks/year	16	Professional judgment; 1 day/week per year; 4 warm months per year	-		-	
Particulate Emission Factor	m^3/kg	1.24E+09	IEPA Default	1.24E+09	IEPA Default	1.24E+09	IEPA Default	1.24E+09	IEPA Default	-		-	
Surface Water - Dermal Contact													
Exposed Skin Surface Area	cm^2	-		-		-		-		-		-	
Event Frequency	events/day	-		-		-		-		-		-	
Exposure Frequency	days/yr	-		-		-		-		-		-	
Exposure Time, Dermal Contact with Surface Water	hr/event	-		-		-		-		-		-	
Sediment - Dermal Contact													
Exposed Skin Surface Area	cm^2	-		-		-		-		-		-	
Skin Adherence Factor	mg/cm^2-event	-		-		-		-		-		-	
Exposure Frequency	days/yr	-		-		-		-		-		-	
Event Frequency	events/day	-		-		-		-		-		-	
Fraction Intake	unitless	-		-		-		-		-		-	
Deer - Ingestion													
Deer Ingestion Rate	g/day	-		-		-		-		28.1	IDNR 2013; USEPA 2011; Family of 4 (2 adults, 1 adolescent, 1 child)	25.0	IDNR 2013; USEPA 2011; Family of 4 (2 adults, 1 adolescent, 1 child)
Exposure Frequency	days/yr	-		-		-		-		365	Averaged over the year	365	Averaged over the year
Fraction of Total Deer Ingested	unitless	-		-		-		-		1	Professional judgment	1	Professional judgment
Fish - Ingestion													
Fish Ingestion Rate	g/day	-		-		-		-		-		-	
Exposure Frequency	days/yr	-		-		-		-		-		-	
Fraction of Total Fish Ingested	unitless	-		-		-		-		-		-	

Notes:
cm^2 = square centimeter
kg = kilogram
L = liter
m^3 = cubic meter
mg = milligram
yr = year

IDNR 2013. Summary of 2012-2013 Illinois Deer Seasons. Illinois Department of Natural Resources. http://www.dnr.illinois.gov/hunting/deer/Documents/IllinoisDeerHarvestReportFinal.2012.2013.pdf

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TABLE 12
HUMAN HEALTH EXPOSURE ASSUMPTIONS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

Parameter	Units	Current/Future On-site Child Deer Consumer	Notes	Future Adult Hikers/Bicycle Users	Notes	Future Adolescent Hikers/Bicycle Users	Notes	Current/Future Off-site Adult Kayaker/Canoeist	Notes	Current/Future Off-site Adolescent Kayaker/Canoeist	Notes	Current/Future Off-site Adult Recreational Angler	Notes
Exposure Areas		**Entire Site**		**Southern Conservation Exposure Area & Railroad Property**		**Southern Conservation Exposure Area & Railroad Property**		**Crab Orchard Creek**		**Crab Orchard Creek**		**Crab Orchard Creek**	
General													
Averaging Time (carcinogenic)	days	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991	25550	USEPA 1991
Averaging Time (noncarcinogenic)	days	1825	ED x 365 days/year	7300	ED x 365 days/year	3650	ED x 365 days/year	10950	ED x 365 days/year	3650	ED x 365 days/year	10950	ED x 365 days/year
Body Weight	kg	16.2	USEPA 2011; 1 - 6 yr age-adjusted body weight	70	USEPA 2002	46.8	USEPA 2011; 6 - 16 yr age-adjusted body weight	70	USEPA 2002	46.8	USEPA 2011; 6 - 16 yr age-adjusted body weight	70	USEPA 2002
Exposure Duration	yr	5	Professional judgment	20	Professional judgment	10	Professional judgment	30	Professional judgment	10	Professional judgment	30	Professional judgment
Soil - Ingestion													
Incidental Soil Ingestion Rate	mg/day	-		100	USEPA 2002	200	USEPA 2002	-		-		-	
Fraction of Total Soil Ingested	unitless	-		0.1	Professional judgment; Section of bike path through the Site is only a fraction of the larger community bike path	0.1	Professional judgment; Section of bike path through the Site is only a fraction of the larger community bike path	-		-		-	
Exposure Frequency	days/yr	-		52	Professional judgment; 1 day per week	52	Professional judgment; 1 day per week	-		-		-	
Soil - Dermal Contact													
Exposed Skin Surface Area	cm^2	-		5700	USEPA 2002; head, hands, forearms, and lower legs	4890	USEPA 2011; Lower legs, feet, forearms and hands	-		-		-	
Skin Adherence Factor	mg/cm^2-event	-		0.07	USEPA 2002	0.2	USEPA 2002	-		-		-	
Exposure Frequency	days/yr	-		52	Professional judgment; 1 day per week	52	Professional judgment; 1 day per week	-		-		-	
Fraction Intake	unitless	-		0.1	Professional judgment	0.1	Professional judgment	-		-		-	
Soil - Inhalation of Dust													
Exposure Time, Inhalation	hr/day	-		1	Professional judgment	1	Professional judgment	-		-		-	
Exposure Frequency	days/yr	-		52	Professional judgment; 1 day per week	52	Professional judgment; 1 day per week	-		-		-	
Particulate Emission Factor	m^3/kg	-		1.24E+09	IEPA Default	1.24E+09	IEPA Default	-		-		-	
Surface Water - Dermal Contact													
Exposed Skin Surface Area	cm^2	-		-		-		5700	USEPA 2002; head, hands, forearms, and lower legs	4890	USEPA 2011; Age-adjusted surface area of head, hands, forearms, feet and lower legs	5700	USEPA 2002; head, hands, forearms, and lower legs
Event Frequency	events/day	-		-		-		1	Professional judgment	1	Professional judgment	1	Professional judgment
Exposure Frequency	days/yr	-		-		-		1	Professional judgment	1	Professional judgment	1	Professional judgment
Exposure Time, Dermal Contact with Surface Water	hr/event	-		-		-		0.5	Professional judgment	0.5	Professional judgment	0.5	Professional judgment
Sediment - Dermal Contact													
Exposed Skin Surface Area	cm^2	-		-		-		2275	USEPA 2011; Mean for hands and feet	1576	USEPA 2011; Age-adjusted mean for hands and feet	2275	USEPA 2011; Mean for hands and feet
Skin Adherence Factor	mg/cm^2-event	-		-		-		1	Maximum possible amount based on considerations of skin monolayer loading capacity.	1	Maximum possible amount based on considerations of skin monolayer loading capacity.	1	Maximum possible amount based on considerations of skin monolayer loading capacity.
Exposure Frequency	days/yr	-		-		-		1	Professional judgment	1	Professional judgment	1	Professional judgment
Event Frequency	events/day	-		-		-		1	Professional judgment	1	Professional judgment	1	Professional judgment
Fraction Intake	unitless	-		-		-		1	Professional judgment	1	Professional judgment	1	Professional judgment
Deer - Ingestion													
Deer Ingestion Rate	g/day	14.2	IDNR 2013; USEPA 2011; Family of 4 (2 adults, 1 adolescent, 1 child)	-		-		-		-		-	
Exposure Frequency	days/yr	365	Averaged over the year	-		-		-		-		-	
Fraction of Total Deer Ingested	unitless	1	Professional judgment	-		-		-		-		-	
Fish - Ingestion													
Fish Ingestion Rate	g/day	-		-		-		-		-		8.1	One 227 g meal per week for a family of 4 (2 adults, 1 adolescent, 1 child)
Exposure Frequency	days/yr	-		-		-		-		-		365	Averaged over the year
Fraction of Total Fish Ingested	unitless	-		-		-		-		-		1	Professional judgment

Notes:
cm^2 = square centimeter
kg = kilogram
L = liter
m^3 = cubic meter
mg = milligram
yr = year

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TABLE 12
HUMAN HEALTH EXPOSURE ASSUMPTIONS
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

Parameter	Units	Current/Future Off-site Adolescent Recreational Angler	Notes	Current/Future Off-site Child Recreational Angler	Notes
Exposure Areas		**Crab Orchard Creek**		**Crab Orchard Creek**	
General					
Averaging Time (carcinogenic)	days	25550	USEPA 1991	25550	USEPA 1991
Averaging Time (noncarcinogenic)	days	3650	ED x 365 days/year	1825	ED x 365 days/year
Body Weight	kg	46.8	USEPA 2011; 6 - 16 yr age-adjusted body weight	16.2	USEPA 2011; 1 - 6 yr age-adjusted body weight
Exposure Duration	yr	10	Professional judgment	5	Professional judgment
Soil - Ingestion					
Incidental Soil Ingestion Rate	mg/day	-		-	
Fraction of Total Soil Ingested	unitless	-		-	
Exposure Frequency	days/yr	-		-	
Soil - Dermal Contact					
Exposed Skin Surface Area	cm^2	-		-	
Skin Adherence Factor	mg/cm^2-event	-		-	
Exposure Frequency	days/yr	-		-	
Fraction Intake	unitless	-		-	
Soil - Inhalation of Dust					
Exposure Time, Inhalation	hr/day	-		-	
Exposure Frequency	days/yr	-		-	
Particulate Emission Factor	m^3/kg	-		-	
Surface Water - Dermal Contact					
Exposed Skin Surface Area	cm^2	4890	USEPA 2011; Age-adjusted surface area of head, hands, forearms, feet and lower legs	-	
Event Frequency	events/day	1	Professional judgment	-	
Exposure Frequency	days/yr	1	Professional judgment	-	
Exposure Time, Dermal Contact with Surface Water	hr/event	0.5	Professional judgment	-	
Sediment - Dermal Contact					
Exposed Skin Surface Area	cm^2	1576	USEPA 2011; Age-adjusted mean for hands and feet	-	
Skin Adherence Factor	mg/cm^2-event	1	Maximum possible amount based on considerations of skin monolayer loading capacity.	-	
Exposure Frequency	days/yr	1	Professional judgment	-	
Event Frequency	events/day	1	Professional judgment	-	
Fraction Intake	unitless	1	Professional judgment	-	
Deer - Ingestion					
Deer Ingestion Rate	g/day	-		-	
Exposure Frequency	days/yr	-		-	
Fraction of Total Deer Ingested	unitless	-		-	
Fish - Ingestion					
Fish Ingestion Rate	g/day	8.1	One 227 g meal per week for a family of 4 (2 adults, 1 adolescent, 1 child)	8.1	One 227 g meal per week for a family of 4 (2 adults, 1 adolescent, 1 child)
Exposure Frequency	days/yr	365	Averaged over the year	365	Averaged over the year
Fraction of Total Fish Ingested	unitless	1	Professional judgment	1	Professional judgment

Notes:
cm^2 = square centimeter
kg = kilogram
L = liter
m^3 = cubic meter
mg = milligram
yr = year

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USEPA 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Office of Research and Development. Washington, DC. 2011.

TABLE 13
SUBCHRONIC NON-CANCER TOXICITY DATA -- ORAL/DERMAL
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal		RfD:Target Organ(s)	
		Value	Units	(1)	Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs							
83-32-9	Acenaphthene	2.0E-01	mg/kg/day	1	2.0E-01	mg/kg/day	PPRTV	September 2014
120-12-7	Anthracene	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	PPRTV	September 2014
50-32-8	BaP TE	NA			NA			
206-44-0	Fluoranthene	1.0E-01	mg/kg/day	1	1.0E-01	mg/kg/day	PPRTV	September 2014
86-73-7	Fluorene	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	IRIS, chronic	11/1/1990
91-20-3	Naphthalene	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	IRIS, chronic	9/17/1998
87-86-5	Pentachlorophenol	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	IRIS, chronic	9/30/2010
85-01-8	Phenanthrene	NA			NA			
108-95-2	Phenol	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	IRIS, chronic	9/30/2002
129-00-0	Pyrene	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	PPRTV	September 2014
	Metals							
7440-38-2	Arsenic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	IRIS, chronic	2/1/1993
7440-47-3	Chromium	1.5E+00	mg/kg/day	0.013	2.0E-02	mg/kg/day	IRIS, chronic	9/3/1998
7440-50-8	Copper	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	HEAST, chronic	1997
	Dioxins/Furans							
1746-01-6	TCDD TEQ	7.0E-10	mg/kg/day	1	7.0E-10	mg/kg/day	IRIS, chronic	2/17/2012

Notes:
(1) Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), July 2004, EPA/540/R/99/005. If not available, assumed to be 100%.
HEAST - Health Effect Assessment Summary Tables, http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=2877#Download
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
PPRTV - Provisional Peer Reviewed Toxicity Values
mg/kg/day - milligrams per kilogram per d RfD - reference dose
NA - not available or not applicable

TABLE 14
SUBCHRONIC NON-CANCER TOXICITY DATA -- INHALATION
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Inhalation RfC		RfC : Target Organ(s)	
		Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs				
50-32-8	BaP TE	NA			
206-44-0	Fluoranthene	NA			
91-20-3	Naphthalene	3.0E-03	mg/m^3	IRIS, chronic	9/17/1998
87-86-5	Pentachlorophenol	NA			
129-00-0	Pyrene	NA			
	Metals				
7440-38-2	Arsenic	1.5E-05	mg/m^3	CalEPA, chronic	June 2014
7440-47-3	Chromium	NA			
7440-50-8	Copper	NA			
	Dioxins/Furans				
1746-01-6	TCDD TEQ	4.0E-08	mg/m^3	CalEPA, chronic	June 2014

Notes:
Cal EPA - California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Inhalation Reference Exposure Levels, http://www.oehha.ca.gov/air/allrels.html
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
NA - not available or not applicable
mg/m^3 - milligrams per cubic meter RfC - reference concentration

TABLE 15
CHRONIC NON-CANCER TOXICITY DATA -- ORAL/DERMAL
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal		RfD:Target Organ(s)	
		Value	Units		Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs							
83-32-9	Acenaphthene	6.0E-02	mg/kg/day	1	6.0E-02	mg/kg/day	IRIS	4/1/1994
120-12-7	Anthracene	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	IRIS	7/1/1993
50-32-8	BaP TE	NA			NA			
206-44-0	Fluoranthene	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	IRIS	7/1/1993
86-73-7	Fluorene	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	IRIS	11/1/1990
91-20-3	Naphthalene	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	IRIS	9/17/1998
87-86-5	Pentachlorophenol	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	IRIS	9/30/2010
85-01-8	Phenanthrene	NA			NA			
108-95-2	Phenol	3.0E-01	mg/kg/day	1	3.0E-01	mg/kg/day	IRIS	9/30/2002
129-00-0	Pyrene	3.0E-02	mg/kg/day	1	3.0E-02	mg/kg/day	IRIS	7/1/1993
	Metals							
7440-38-2	Arsenic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	IRIS	2/1/1993
7440-47-3	Chromium	1.5E+00	mg/kg/day	0.013	2.0E-02	mg/kg/day	IRIS	9/3/1998
7440-50-8	Copper	4.0E-02	mg/kg/day	1	4.0E-02	mg/kg/day	HEAST	1997
	Dioxins/Furans							
1746-01-6	TCDD TEQ	7.0E-10	mg/kg/day	1	7.0E-10	mg/kg/day	IRIS	2/17/2012

Notes:
(1) Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), July 2004, EPA/540/R/99/005. If not available, assumed to be 100%.
HEAST - Health Effect Assessment Summary Tables, http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=2877#Download
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
mg/kg/day - milligrams per kilogram per day RfD - reference dose
NA - not available or not applicable

TABLE 16
CHRONIC NON-CANCER TOXICITY DATA -- INHALATION
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Inhalation RfC		RfC : Target Organ(s)	
		Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs				
50-32-8	BaP TE	NA			
206-44-0	Fluoranthene	NA			
91-20-3	Naphthalene	3.0E-03	mg/m^3	IRIS	9/17/1998
87-86-5	Pentachlorophenol	NA			
129-00-0	Pyrene	NA			
	Metals				
7440-38-2	Arsenic	1.5E-05	mg/m^3	CalEPA	June 2014
7440-47-3	Chromium	NA			
7440-50-8	Copper	NA			
	Dioxins/Furans				
1746-01-6	TCDD TEQ	4.0E-08	mg/m^3	CalEPA	June 2014

Notes:
Cal EPA - California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Inhalation Reference Exposure Levels,
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
NA - not available or not applicable
mg/m^3 - milligrams per cubic meter RfC - reference concentration

TABLE 17
CANCER TOXICITY DATA -- ORAL/DERMAL
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal		Oral CSF	
		Value	Units		Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs							
83-32-9	Acenaphthene	NA			NA			
120-12-7	Anthracene	NA			NA			
50-32-8	BaP TE	7.3E+00	$(mg/kg\text{-}day)^{-1}$	1	7.3E+00	$(mg/kg\text{-}day)^{-1}$	IRIS	11/1/1994
206-44-0	Fluoranthene	NA			NA			
86-73-7	Fluorene	NA			NA			
91-20-3	Naphthalene	NA			NA			
87-86-5	Pentachlorophenol	4.0E-01	$(mg/kg\text{-}day)^{-1}$	1	4.0E-01	$(mg/kg\text{-}day)^{-1}$	IRIS	9/30/2010
85-01-8	Phenanthrene	NA			NA			
108-95-2	Phenol	NA			NA			
129-00-0	Pyrene	NA			NA			
	Metals							
7440-38-2	Arsenic	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1	1.5E+00	$(mg/kg\text{-}day)^{-1}$	IRIS	4/10/1998
7440-47-3	Chromium	NA			NA			
7440-50-8	Copper	NA			NA			
	Dioxins/Furans							
1746-01-6	TCDD TEQ	1.3E+05	$(mg/kg\text{-}day)^{-1}$	1	1.3E+05	$(mg/kg\text{-}day)^{-1}$	HEAST	1997

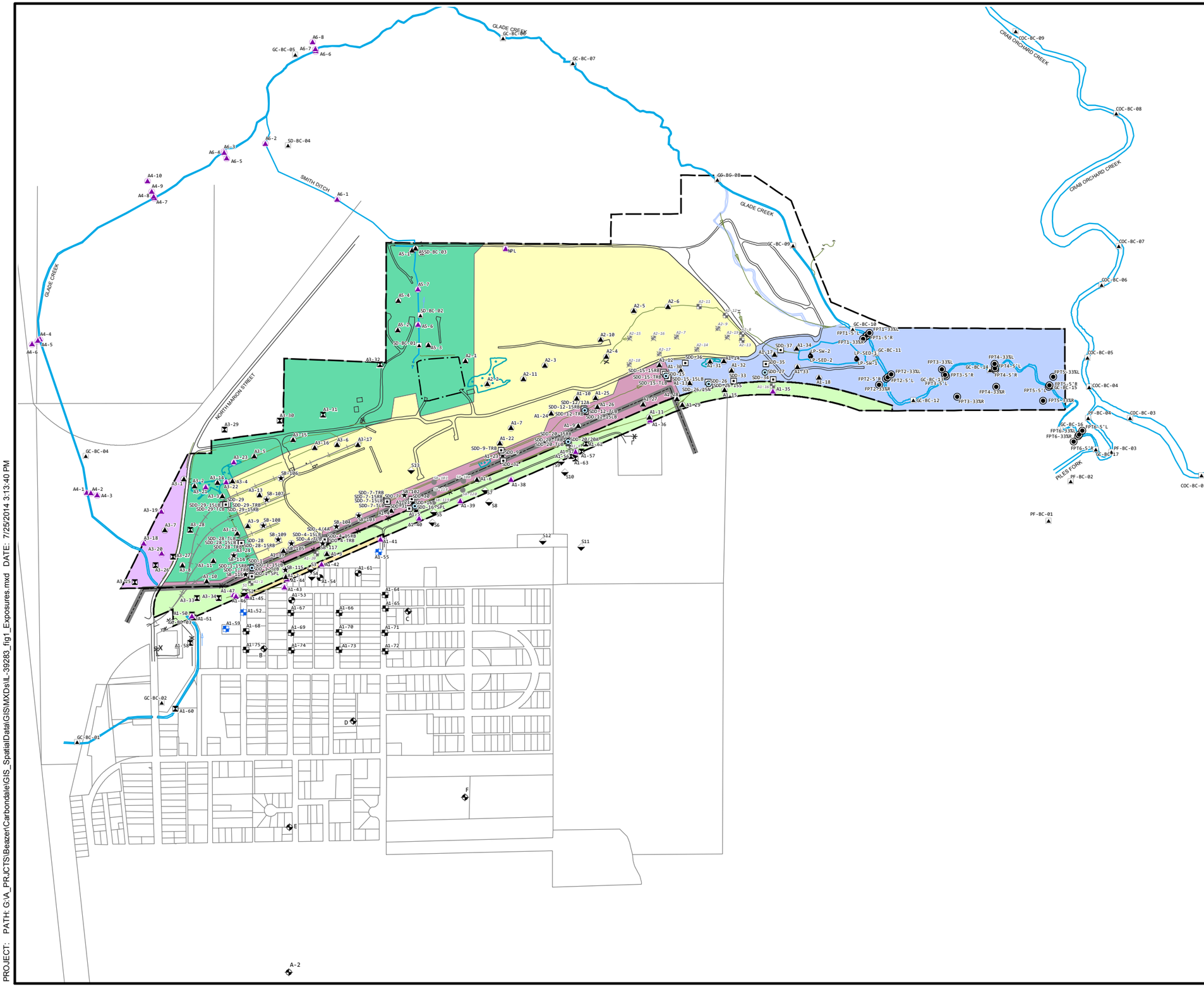
Notes:
(1) Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), July 2004, EPA/540/R/99/005. If not available, assumed to be 100%.
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
CSF - cancer slope factor
NA - not available or not applicable
$(mg/kg\text{-}day)^{-1}$ - per milligram per kilogram per day

TABLE 18
CANCER TOXICITY DATA -- INHALATION
FORMER KOPPERS WOOD-TREATING SITE, CARBONDALE, ILLINOIS

CAS Number	Chemical of Potential Concern	Unit Risk		Unit Risk : Inhalation CSF	
		Value	Units	Source(s)	Date(s) (MM/DD/YYYY)
	SVOCs				
50-32-8	BaP TE	1.1E-03	$(ug/m^3)^{-1}$	CalEPA	7/21/2009
206-44-0	Fluoranthene	NA			
91-20-3	Naphthalene	3.4E-05	$(ug/m^3)^{-1}$	CalEPA	7/21/2009
87-86-5	Pentachlorophenol	5.1E-06	$(ug/m^3)^{-1}$	CalEPA	7/21/2009
129-00-0	Pyrene	NA			
	Metals				
7440-38-2	Arsenic	4.3E-03	$(ug/m^3)^{-1}$	IRIS	4/10/1998
7440-47-3	Chromium	NA			
7440-50-8	Copper	NA			
	Dioxins/Furans				
1746-01-6	TCDD TEQ	3.8E+01	$(ug/m^3)^{-1}$	CalEPA	7/21/2009

Notes:
Cal EPA - California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Cancer Potency Values, http://www.oehha.ca.gov/risk/pdf/tcdb072109alpha.pdf
IRIS - Integrated Risk Information System; http://www.epa.gov/iris/
PPRTV - Provisional Peer Reviewed Toxicity Values
CSF - cancer slope factor
$(ug/m^3)^{-1}$ - per microgram per cubic meter
NA - not available or not applicable

Figures



LEGEND:

- 2005 EPA SAMPLE
- 2005 SURFACE COVER
- 2006 SOUTHERN DRAINAGE
- 2008 SOUTHERN DRAINAGE
- 2009 SP LOCATION
- 2010 SP LOCATION
- BCWP
- COMPOSITE AUG 2012
- COMPOSITE NOV 2012
- FLOODPLAIN SAMPLE
- GRAB- AUG 2012
- RESIDENTIAL
- SEDIMENT-SURFACE WATER
- SP-USEPA
- COVERED- FORMER LAGOON
- REMOVED SAMPLES
- REMOVED EPA SAMPLE
- REMOVED SB- SOIL/DEBRIS PILE AREA
- DRAINAGE DITCH
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- WETLAND
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- PROPERTY LINE
- CAMU CONTAINMENT AREA
- POTENTIAL BIKE PATH
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA

0 600 1,200

SCALE IN FEET

BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

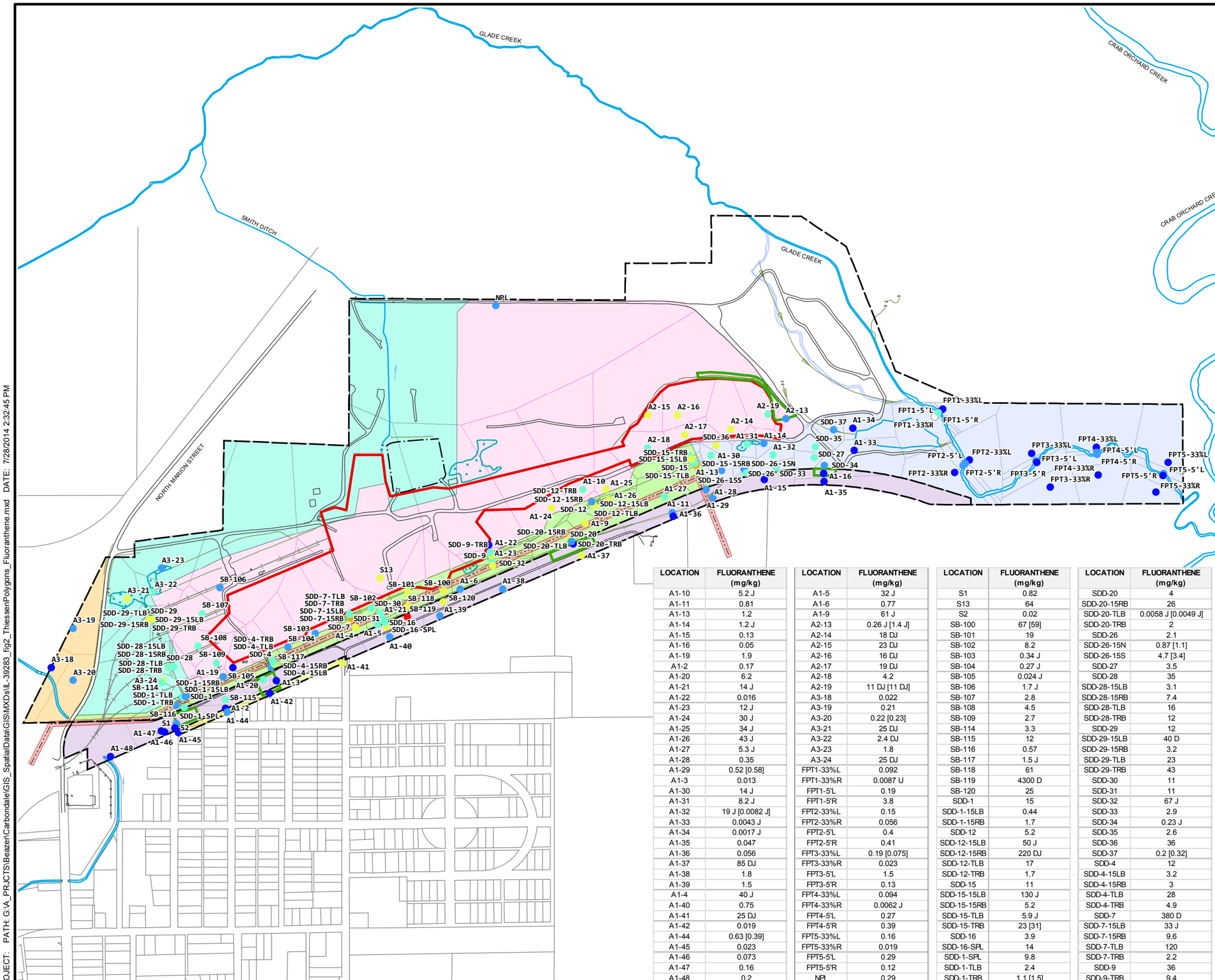
EXPOSURE AREAS

ARCADIS

FIGURE

1

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\Carbondale\GIS_Spatial\Data\GIS\MXDs\IL-39283_fig1_Exposures.mxd DATE: 7/25/2014 3:13:40 PM



LOCATION	FLUORANTHENE (mg/kg)
A1-10	5.2 J
A1-11	0.81
A1-13	1.2
A1-14	1.2 J
A1-15	0.13
A1-16	0.05
A1-19	1.9
A1-2	0.17
A1-20	6.2
A1-21	14 J
A1-22	0.016
A1-23	12 J
A1-24	30 J
A1-25	34 J
A1-26	43 J
A1-27	5.3 J
A1-28	0.35
A1-29	0.52 [0.58]
A1-3	0.013
A1-30	14 J
A1-31	8.2 J
A1-32	19 J [0.0082 J]
A1-33	0.0043 J
A1-34	0.0017 J
A1-35	0.047
A1-36	0.056
A1-37	85 DJ
A1-38	1.8
A1-39	1.5
A1-4	40 J
A1-40	0.75
A1-41	25 DJ
A1-42	0.019
A1-44	0.63 [0.39]
A1-45	0.023
A1-46	0.073
A1-47	0.16
A1-48	0.2

LOCATION	FLUORANTHENE (mg/kg)
A1-5	32 J
A1-6	0.77
A1-9	61 J
A2-13	0.26 J [1.4 J]
A2-14	18 DJ
A2-15	23 DJ
A2-16	16 DJ
A2-17	19 DJ
A2-18	4.2
A2-19	11 DJ [11 DJ]
A3-18	0.022
A3-19	0.21
A3-20	0.22 [0.23]
A3-21	25 DJ
A3-22	2.4 DJ
A3-23	1.8
A3-24	25 DJ
FPT1-33%L	0.092
FPT1-33%R	0.0087 U
FPT1-5'L	0.19
FPT1-5'R	3.8
FPT2-33%L	0.15
FPT2-33%R	0.056
FPT2-5'L	0.4
FPT2-5'R	0.41
FPT3-33%L	0.19 [0.075]
FPT3-33%R	0.023
FPT3-5'L	1.5
FPT3-5'R	0.13
FPT4-33%L	0.094
FPT4-33%R	0.0062 J
FPT4-5'L	0.27
FPT4-5'R	0.39
FPT5-33%L	0.16
FPT5-33%R	0.019
FPT5-5'L	0.29
FPT5-5'R	0.12
NPL	0.29

LOCATION	FLUORANTHENE (mg/kg)
S1	0.82
S13	64
S2	0.02
SB-100	67 [59]
SB-101	19
SB-102	8.2
SB-103	0.34 J
SB-104	0.27 J
SB-105	0.024 J
SB-106	1.7 J
SB-107	2.8
SB-108	4.5
SB-109	2.7
SB-114	3.3
SB-115	12
SB-116	0.57
SB-117	1.5 J
SB-118	61
SB-119	4300 D
SB-120	25
SDD-1	15
SDD-1-15LB	0.44
SDD-1-15RB	1.7
SDD-12	5.2
SDD-12-15LB	50 J
SDD-12-15RB	220 DJ
SDD-12-TLB	17
SDD-12-TRB	1.7
SDD-15	11
SDD-15-15LB	130 J
SDD-15-15RB	5.2
SDD-15-TLB	5.9 J
SDD-15-TRB	23 [31]
SDD-16	3.9
SDD-16-SPL	14
SDD-1-SPL	9.8
SDD-1-TLB	2.4
SDD-1-TRB	1.1 [1.5]

LOCATION	FLUORANTHENE (mg/kg)
SDD-20	4
SDD-20-15RB	26
SDD-20-TLB	0.0058 J [0.0049 J]
SDD-20-TRB	2
SDD-26	2.1
SDD-26-15N	0.87 [1.1]
SDD-26-15S	4.7 [3.4]
SDD-27	3.5
SDD-28	35
SDD-28-15LB	3.1
SDD-28-15RB	7.4
SDD-28-TLB	16
SDD-28-TRB	12
SDD-29	12
SDD-29-15LB	40 D
SDD-29-15RB	3.2
SDD-29-TLB	23
SDD-29-TRB	43
SDD-30	11
SDD-31	11
SDD-32	67 J
SDD-33	2.9
SDD-34	0.23 J
SDD-35	2.6
SDD-36	36
SDD-37	0.2 [0.32]
SDD-4	12
SDD-4-15LB	3.2
SDD-4-15RB	3
SDD-4-TLB	28
SDD-4-TRB	4.9
SDD-7	380 D
SDD-7-15LB	33 J
SDD-7-15RB	9.6
SDD-7-TLB	120
SDD-7-TRB	2.2
SDD-9	36
SDD-9-TRB	9.4

LEGEND:

FLUORANTHENE (mg/kg)

- NOT DETECTED
- ≤ 0.2
- 0.2 - 2
- 2 - 14
- 14 - 95
- 95 - 640
- > 640
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

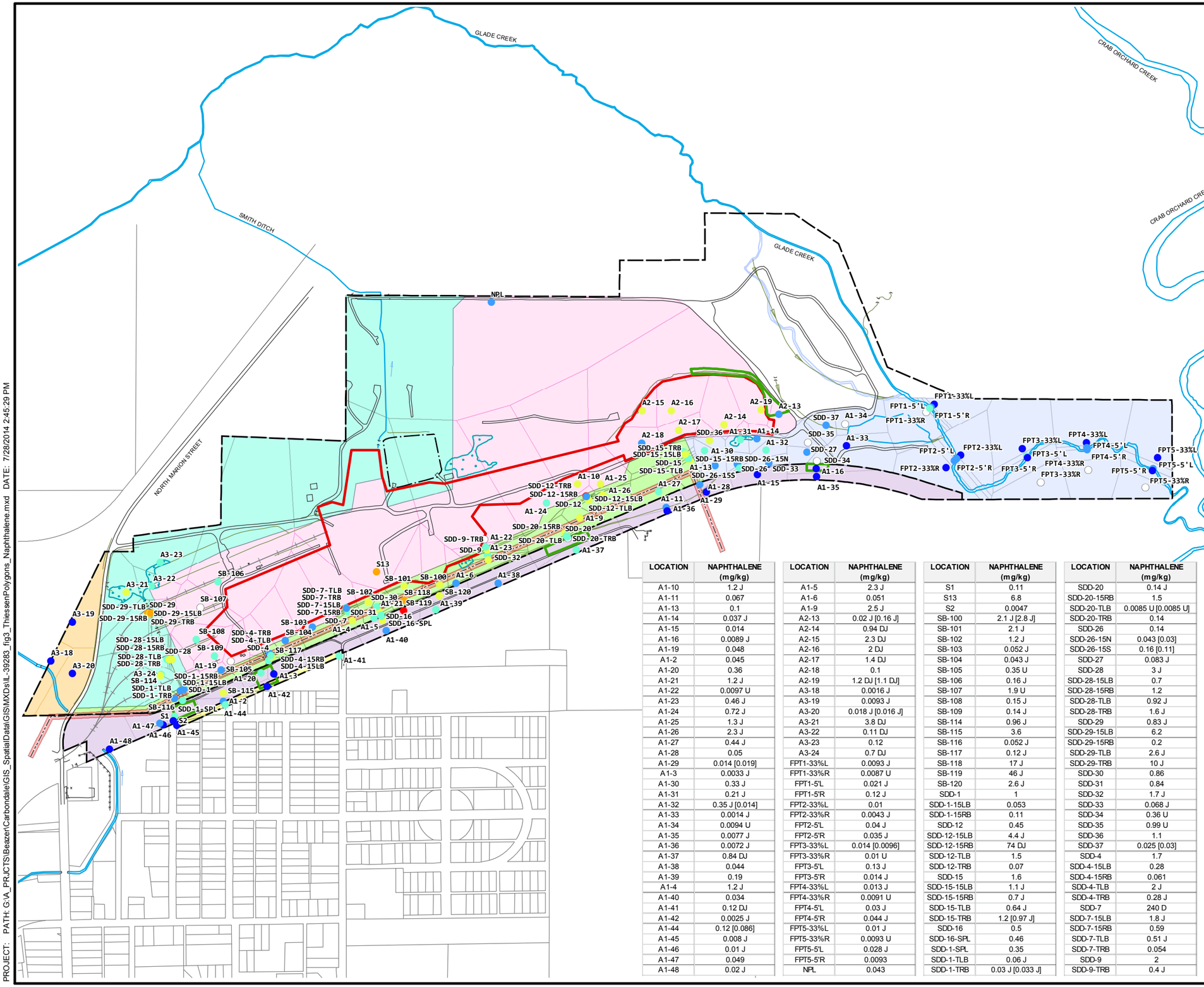
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

FLUORANTHENE THIESSEN POLYGON MAP

ARCADIS

FIGURE 2

CITY: CHELMSFORD DIV/GROUP: ENV/WEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\Carbondale\GIS_Spatial\Data\GIS\MXD\IL-39283_fig2_ThiessenPolygons_Fluoranthene.mxd DATE: 7/28/2014 2:32:45 PM



LOCATION	NAPHTHALENE (mg/kg)	LOCATION	NAPHTHALENE (mg/kg)	LOCATION	NAPHTHALENE (mg/kg)	LOCATION	NAPHTHALENE (mg/kg)
A1-10	1.2 J	A1-5	2.3 J	S1	0.11	SDD-20	0.14 J
A1-11	0.067	A1-6	0.051	S13	6.8	SDD-20-15RB	1.5
A1-13	0.1	A1-9	2.5 J	S2	0.0047	SDD-20-TLB	0.0085 U [0.0085 U]
A1-14	0.037 J	A2-13	0.02 J [0.16 J]	SB-100	2.1 J [2.8 J]	SDD-20-TRB	0.14
A1-15	0.014	A2-14	0.94 DJ	SB-101	2.1 J	SDD-26	0.14
A1-16	0.0089 J	A2-15	2.3 DJ	SB-102	1.2 J	SDD-26-15N	0.043 [0.03]
A1-19	0.048	A2-16	2 DJ	SB-103	0.052 J	SDD-26-15S	0.16 [0.11]
A1-2	0.045	A2-17	1.4 DJ	SB-104	0.043 J	SDD-27	0.083 J
A1-20	0.36	A2-18	0.1	SB-105	0.35 U	SDD-28	3 J
A1-21	1.2 J	A2-19	1.2 DJ [1.1 DJ]	SB-106	0.16 J	SDD-28-15LB	0.7
A1-22	0.0097 U	A3-18	0.0016 J	SB-107	1.9 U	SDD-28-15RB	1.2
A1-23	0.46 J	A3-19	0.0093 J	SB-108	0.15 J	SDD-28-TLB	0.92 J
A1-24	0.72 J	A3-20	0.018 J [0.016 J]	SB-109	0.14 J	SDD-28-TRB	1.6 J
A1-25	1.3 J	A3-21	3.8 DJ	SB-114	0.96 J	SDD-29	0.83 J
A1-26	2.3 J	A3-22	0.11 DJ	SB-115	3.6	SDD-29-15LB	6.2
A1-27	0.44 J	A3-23	0.12	SB-116	0.052 J	SDD-29-15RB	0.2
A1-28	0.05	A3-24	0.7 DJ	SB-117	0.12 J	SDD-29-TLB	2.6 J
A1-29	0.014 [0.019]	FPT1-33%L	0.0093 J	SB-118	17 J	SDD-29-TRB	10 J
A1-3	0.0033 J	FPT1-33%R	0.0087 U	SB-119	46 J	SDD-30	0.86
A1-30	0.33 J	FPT1-5'L	0.021 J	SB-120	2.6 J	SDD-31	0.84
A1-31	0.21 J	FPT1-5'R	0.12 J	SDD-1	1	SDD-32	1.7 J
A1-32	0.35 J [0.014]	FPT2-33%L	0.01	SDD-1-15LB	0.053	SDD-33	0.068 J
A1-33	0.0014 J	FPT2-33%R	0.0043 J	SDD-1-15RB	0.11	SDD-34	0.36 U
A1-34	0.0094 U	FPT2-5'L	0.04 J	SDD-12	0.45	SDD-35	0.99 U
A1-35	0.0077 J	FPT2-5'R	0.035 J	SDD-12-15LB	4.4 J	SDD-36	1.1
A1-36	0.0072 J	FPT3-33%L	0.014 [0.0096]	SDD-12-15RB	74 DJ	SDD-37	0.025 [0.03]
A1-37	0.84 DJ	FPT3-33%R	0.01 U	SDD-12-TLB	1.5	SDD-4	1.7
A1-38	0.044	FPT3-5'L	0.13 J	SDD-12-TRB	0.07	SDD-4-15LB	0.28
A1-39	0.19	FPT3-5'R	0.014 J	SDD-15	1.6	SDD-4-15RB	0.061
A1-4	1.2 J	FPT4-33%L	0.013 J	SDD-15-15LB	1.1 J	SDD-4-TLB	2 J
A1-40	0.034	FPT4-33%R	0.0091 U	SDD-15-15RB	0.7 J	SDD-4-TRB	0.28 J
A1-41	0.12 DJ	FPT4-5'L	0.03 J	SDD-15-TLB	0.64 J	SDD-7	240 D
A1-42	0.0025 J	FPT4-5'R	0.044 J	SDD-15-TRB	1.2 [0.97 J]	SDD-7-15LB	1.8 J
A1-44	0.12 [0.086]	FPT5-33%L	0.01 J	SDD-16	0.5	SDD-7-15RB	0.59
A1-45	0.008 J	FPT5-33%R	0.0093 U	SDD-16-SPL	0.46	SDD-7-TLB	0.51 J
A1-46	0.01 J	FPT5-5'L	0.028 J	SDD-1-SPL	0.35	SDD-7-TRB	0.054
A1-47	0.049	FPT5-5'R	0.0093	SDD-1-TLB	0.06 J	SDD-9	2
A1-48	0.02 J	NPL	0.043	SDD-1-TRB	0.03 J [0.033 J]	SDD-9-TRB	0.4 J

LEGEND:

NAPHTHALENE (mg/kg)

- NOT DETECTED
- ≤ 0.02
- 0.02 - 0.1
- 0.1 - 0.9
- 0.9 - 6
- 6 - 37
- > 37
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

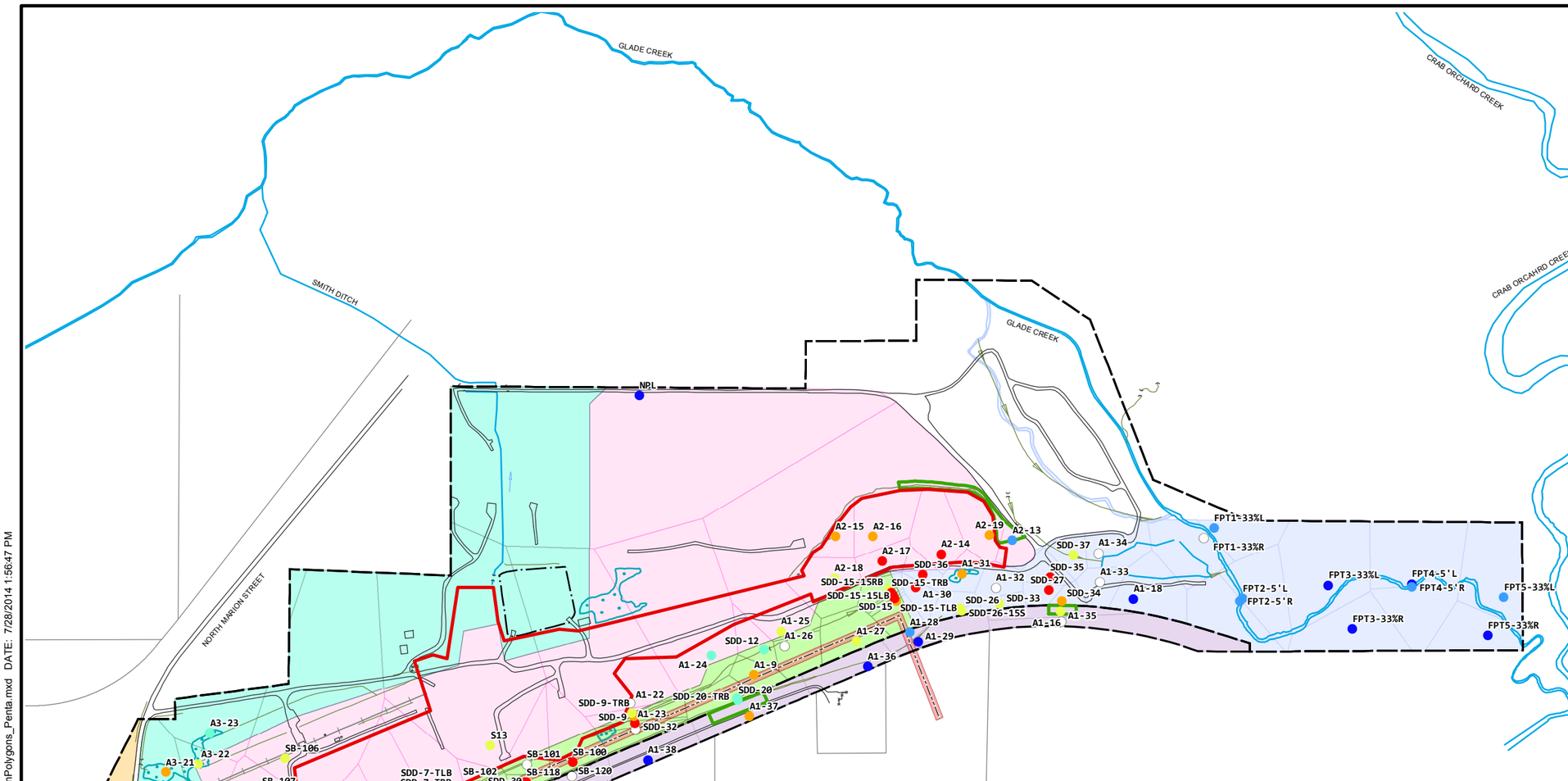
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

NAPHTHALENE THIESSEN POLYGON MAP

ARCADIS

FIGURE 3

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\CarbondaleGIS_SpatialData\GIS\MXDs\IL-39283_fig3_ThiessenPolygons_Naphthalene.mxd DATE: 7/28/2014 2:45:29 PM



LOCATION	PENTACHLOROPHENOL (mg/kg)
A1-16	2.2 D
A1-18	0.017 J
A1-19	0.44
A1-2	0.046 U
A1-20	0.57
A1-21	140 J
A1-22	0.048 U
A1-23	31 J
A1-24	0.7 J
A1-25	2.6 J
A1-26	5.4 UJ
A1-27	2.2 J
A1-28	0.099
A1-29	0.017 J [0.018 J]
A1-3	0.044 U
A1-30	63 J
A1-31	22 J
A1-32	1.1 UJ [0.046 UJ]
A1-33	0.046 U
A1-34	0.046 U
A1-35	0.048 U
A1-36	0.022 J
A1-37	8 DJ
A1-38	0.033 J
A1-39	0.26
A1-4	4.5 UJ
A1-40	0.023 J
A1-41	0.79 UJ
A1-41	0.79 UJ

LOCATION	PENTACHLOROPHENOL (mg/kg)
A1-42	0.093 U
A1-42	0.093 U
A1-44	0.021 J [0.04 J]
A1-44	0.021 J [0.04 J]
A1-45	0.046 U
A1-45	0.046 U
A1-46	0.11 U
A1-47	0.022 J
A1-48	0.13 U
A1-5	2.8 UJ
A1-9	21 J
A2-13	0.078 J [0.061 J]
A2-14	71 DJ
A2-15	21 DJ
A2-16	27 DJ
A2-17	40 DJ
A2-18	2.3
A2-19	22 DJ [20 DJ]
A3-18	0.044 U
A3-19	0.067 J
A3-20	0.037 J [0.053 J]
A3-21	18 DJ
A3-22	1.2 DJ
A3-23	0.57
A3-24	2.6 DJ
FPT1-33%L	0.22
FPT1-33%R	0.043 U
FPT2-5'L	0.098 J
FPT2-5'R	0.14 J

LOCATION	PENTACHLOROPHENOL (mg/kg)
FPT3-33%L	0.065 [0.018 J]
FPT3-33%R	0.02 J
FPT4-5'L	0.047 J
FPT4-5'R	0.075 J
FPT5-33%L	0.062 J
FPT5-33%R	0.01 J
NPL	0.016 J
S1	0.51 U
S13	2.2
S2	0.47 U
SB-100	48 J [53 J]
SB-101	88 U
SB-102	11 U
SB-103	1.8 U
SB-104	1.8 U
SB-105	1.7 U
SB-106	3.4 J
SB-107	9.4 U
SB-108	10 U
SB-109	9.1 U
SB-114	13 U
SB-115	3.2 J
SB-116	1.8 U
SB-117	9.6 U
SB-118	57 J
SB-119	870 U
SB-120	20 U
SDD-1	2.2 J
SDD-12	0.58 J

LOCATION	PENTACHLOROPHENOL (mg/kg)
SDD-15	45 DJ
SDD-15-15LB	17 J
SDD-15-15RB	2.9
SDD-15-TLB	100 J
SDD-15-TRB	68 [60]
SDD-16	89 DJ
SDD-16-SPL	0.54 J
SDD-20	0.51 J
SDD-20-TRB	0.32
SDD-26	2.8 J
SDD-26-15S	1.5
SDD-27	33 DJ
SDD-29-TLB	1.3
SDD-30	0.99 U
SDD-31	19
SDD-32	11 UJ
SDD-33	1.4
SDD-34	20
SDD-35	45
SDD-36	89
SDD-37	0.83 [1.4]
SDD-4	1.1 J
SDD-7	4.2 J
SDD-7-15LB	0.55 J
SDD-7-TLB	8.4
SDD-7-TRB	0.23
SDD-9	10 J
SDD-9-TRB	5.5

LEGEND:

PENTACHLOROPHENOL (mg/kg)

- NOT DETECTED
- ≤ 0.06
- 0.06 - 0.3
- 0.3 - 1
- 1 - 6
- 6 - 30
- > 30
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

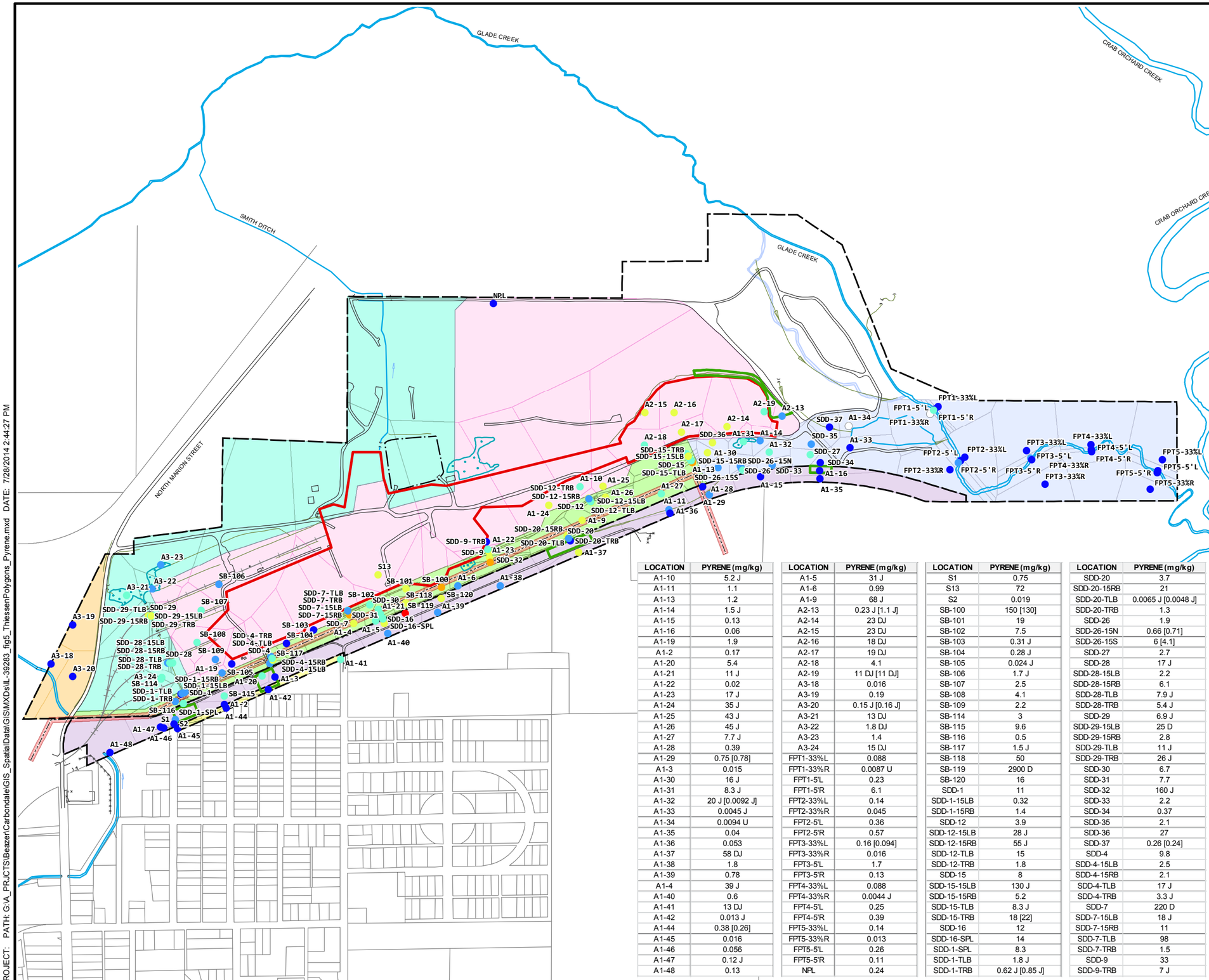
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

PENTACHLOROPHENOL THIESSEN POLYGON MAP

ARCADIS

FIGURE 4

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\Carbondale\GIS_Spatial\Data\GIS\MXDs\IL-39283_fig4_ThiessenPolygons_Penta.mxd DATE: 7/28/2014 1:56:47 PM



LOCATION	PYRENE (mg/kg)
A1-10	5.2 J
A1-11	1.1
A1-13	1.2
A1-14	1.5 J
A1-15	0.13
A1-16	0.06
A1-19	1.9
A1-2	0.17
A1-20	5.4
A1-21	11 J
A1-22	0.02
A1-23	17 J
A1-24	35 J
A1-25	43 J
A1-26	45 J
A1-27	7.7 J
A1-28	0.39
A1-29	0.75 [0.78]
A1-3	0.015
A1-30	16 J
A1-31	8.3 J
A1-32	20 J [0.0092 J]
A1-33	0.0045 J
A1-34	0.0094 U
A1-35	0.04
A1-36	0.053
A1-37	58 DJ
A1-38	1.8
A1-39	0.78
A1-4	39 J
A1-40	0.6
A1-41	13 DJ
A1-42	0.013 J
A1-44	0.38 [0.26]
A1-45	0.016
A1-46	0.056
A1-47	0.12 J
A1-48	0.13

LOCATION	PYRENE (mg/kg)
A1-5	31 J
A1-6	0.99
A1-9	68 J
A2-13	0.23 J [1.1 J]
A2-14	23 DJ
A2-15	23 DJ
A2-16	18 DJ
A2-17	19 DJ
A2-18	4.1
A2-19	11 DJ [11 DJ]
A3-18	0.016
A3-19	0.19
A3-20	0.15 J [0.16 J]
A3-21	13 DJ
A3-22	1.8 DJ
A3-23	1.4
A3-24	15 DJ
FPT1-33%L	0.088
FPT1-33%R	0.0087 U
FPT1-5'L	0.23
FPT1-5'R	6.1
FPT2-33%L	0.14
FPT2-33%R	0.045
FPT2-5'L	0.36
FPT2-5'R	0.57
FPT3-33%L	0.16 [0.094]
FPT3-33%R	0.016
FPT3-5'L	1.7
FPT3-5'R	0.13
FPT4-33%L	0.088
FPT4-33%R	0.0044 J
FPT4-5'L	0.25
FPT4-5'R	0.39
FPT5-33%L	0.14
FPT5-33%R	0.013
FPT5-5'L	0.26
FPT5-5'R	0.11
NPL	0.24

LOCATION	PYRENE (mg/kg)
S1	0.75
S13	72
S2	0.019
SB-100	150 [130]
SB-101	19
SB-102	7.5
SB-103	0.31 J
SB-104	0.28 J
SB-105	0.024 J
SB-106	1.7 J
SB-107	2.5
SB-108	4.1
SB-109	2.2
SB-114	3
SB-115	9.6
SB-116	0.5
SB-117	1.5 J
SB-118	50
SB-119	2900 D
SB-120	16
SDD-1	11
SDD-1-15LB	0.32
SDD-1-15RB	1.4
SDD-12	3.9
SDD-12-15LB	28 J
SDD-12-15RB	55 J
SDD-12-TLB	15
SDD-12-TRB	1.8
SDD-15	8
SDD-15-15LB	130 J
SDD-15-15RB	5.2
SDD-15-TLB	8.3 J
SDD-15-TRB	18 [22]
SDD-16	12
SDD-16-SPL	14
SDD-1-SPL	8.3
SDD-1-TLB	1.8 J
SDD-1-TRB	0.62 J [0.85 J]

LOCATION	PYRENE (mg/kg)
SDD-20	3.7
SDD-20-15RB	21
SDD-20-TLB	0.0065 J [0.0048 J]
SDD-20-TRB	1.3
SDD-26	1.9
SDD-26-15N	0.66 [0.71]
SDD-26-15S	6 [4.1]
SDD-27	2.7
SDD-28	17 J
SDD-28-15LB	2.2
SDD-28-15RB	6.1
SDD-28-TLB	7.9 J
SDD-28-TRB	5.4 J
SDD-29	6.9 J
SDD-29-15LB	25 D
SDD-29-15RB	2.8
SDD-29-TLB	11 J
SDD-29-TRB	26 J
SDD-30	6.7
SDD-31	7.7
SDD-32	160 J
SDD-33	2.2
SDD-34	0.37
SDD-35	2.1
SDD-36	27
SDD-37	0.26 [0.24]
SDD-4	9.8
SDD-4-15LB	2.5
SDD-4-15RB	2.1
SDD-4-TLB	17 J
SDD-4-TRB	3.3 J
SDD-7	220 D
SDD-7-15LB	18 J
SDD-7-15RB	11
SDD-7-TLB	98
SDD-7-TRB	1.5
SDD-9	33
SDD-9-TRB	7 J

LEGEND:

PYRENE (mg/kg)

- NOT DETECTED
- ≤ 0.4
- 0.4 - 2.4
- 2.4 - 15
- 15 - 85
- 85 - 500
- > 500
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

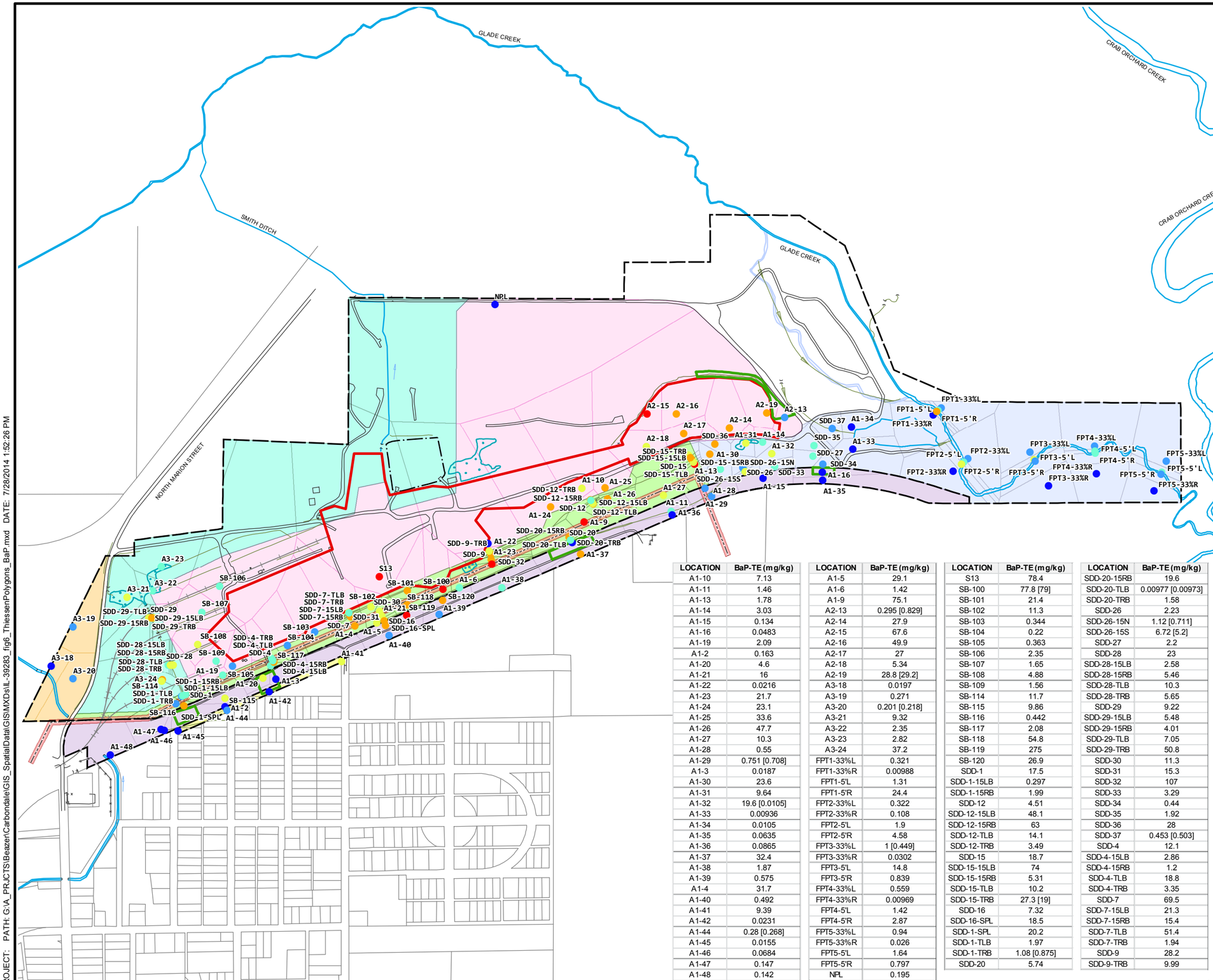
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

PYRENE THIESSEN POLYGON MAP

ARCADIS

FIGURE 5

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\CarbondaleGIS_SpatialData\GIS\MXDs\IL-39283_fig5_ThiessenPolygons_Pyrene.mxd DATE: 7/28/2014 2:44:27 PM



LOCATION	BaP-TE (mg/kg)
A1-10	7.13
A1-11	1.46
A1-13	1.78
A1-14	3.03
A1-15	0.134
A1-16	0.0483
A1-19	2.09
A1-2	0.163
A1-20	4.6
A1-21	16
A1-22	0.0216
A1-23	21.7
A1-24	23.1
A1-25	33.6
A1-26	47.7
A1-27	10.3
A1-28	0.55
A1-29	0.751 [0.708]
A1-3	0.0187
A1-30	23.6
A1-31	9.64
A1-32	19.6 [0.0105]
A1-33	0.00936
A1-34	0.0105
A1-35	0.0635
A1-36	0.0865
A1-37	32.4
A1-38	1.87
A1-39	0.575
A1-4	31.7
A1-40	0.492
A1-41	9.39
A1-42	0.0231
A1-44	0.28 [0.268]
A1-45	0.0155
A1-46	0.0684
A1-47	0.147
A1-48	0.142

LOCATION	BaP-TE (mg/kg)
A1-5	29.1
A1-6	1.42
A1-9	75.1
A2-13	0.295 [0.829]
A2-14	27.9
A2-15	67.6
A2-16	49.9
A2-17	27
A2-18	5.34
A2-19	28.8 [29.2]
A3-18	0.0197
A3-19	0.271
A3-20	0.201 [0.218]
A3-21	9.32
A3-22	2.35
A3-23	2.82
A3-24	37.2
FPT1-33%L	0.321
FPT1-33%R	0.00988
FPT1-5'L	1.31
FPT1-5'R	24.4
FPT2-33%L	0.322
FPT2-33%R	0.108
FPT2-5'L	1.9
FPT2-5'R	4.58
FPT3-33%L	1 [0.449]
FPT3-33%R	0.0302
FPT3-5'L	14.8
FPT3-5'R	0.839
FPT4-33%L	0.559
FPT4-33%R	0.00969
FPT4-5'L	1.42
FPT4-5'R	2.87
FPT5-33%L	0.94
FPT5-33%R	0.026
FPT5-5'L	1.64
FPT5-5'R	0.797
NPL	0.195

LOCATION	BaP-TE (mg/kg)
S13	78.4
SB-100	77.8 [79]
SB-101	21.4
SB-102	11.3
SB-103	0.344
SB-104	0.22
SB-105	0.363
SB-106	2.35
SB-107	1.65
SB-108	4.88
SB-109	1.56
SB-114	11.7
SB-115	9.86
SB-116	0.442
SB-117	2.08
SB-118	54.8
SB-119	275
SB-120	26.9
SDD-1	17.5
SDD-1-15LB	0.297
SDD-1-15RB	1.99
SDD-12	4.51
SDD-12-15LB	48.1
SDD-12-15RB	63
SDD-12-TLB	14.1
SDD-12-TRB	3.49
SDD-15	18.7
SDD-15-15LB	74
SDD-15-15RB	5.31
SDD-15-TLB	10.2
SDD-15-TRB	27.3 [19]
SDD-16	7.32
SDD-16-SPL	18.5
SDD-1-SPL	20.2
SDD-1-TLB	1.97
SDD-1-TRB	1.08 [0.875]
SDD-20	5.74

LOCATION	BaP-TE (mg/kg)
SDD-20-15RB	19.6
SDD-20-TLB	0.00977 [0.00973]
SDD-20-TRB	1.58
SDD-26	2.23
SDD-26-15N	1.12 [0.711]
SDD-26-15S	6.72 [5.2]
SDD-27	2.2
SDD-28	23
SDD-28-15LB	2.58
SDD-28-15RB	5.46
SDD-28-TLB	10.3
SDD-28-TRB	5.65
SDD-29	9.22
SDD-29-15LB	5.48
SDD-29-15RB	4.01
SDD-29-TLB	7.05
SDD-29-TRB	50.8
SDD-30	11.3
SDD-31	15.3
SDD-32	107
SDD-33	3.29
SDD-34	0.44
SDD-35	1.92
SDD-36	28
SDD-37	0.453 [0.503]
SDD-4	12.1
SDD-4-15LB	2.86
SDD-4-15RB	1.2
SDD-4-TLB	18.8
SDD-4-TRB	3.35
SDD-7	69.5
SDD-7-15LB	21.3
SDD-7-15RB	15.4
SDD-7-TLB	51.4
SDD-7-TRB	1.94
SDD-9	28.2
SDD-9-TRB	9.99

LEGEND:

BaP-TE (mg/kg)

- ≤ 0.2
- 0.2 - 0.95
- 0.95 - 4
- 4 - 17
- 17 - 67
- > 67
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

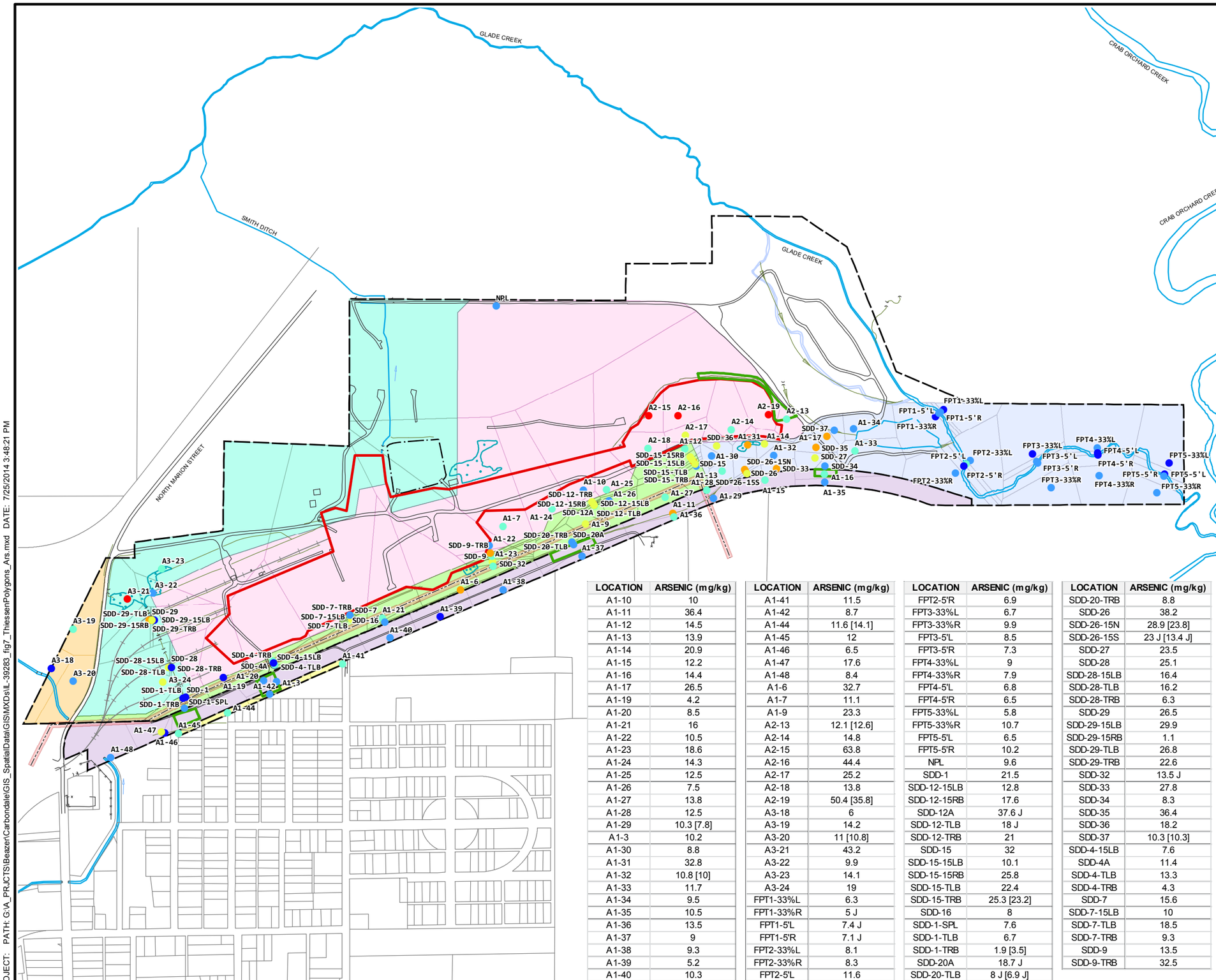
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

BAP-TE THIESSEN POLYGON MAP

ARCADIS

FIGURE 6

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\CarbondaleGIS_SpatialData\GIS\MXDs\IL-39283_fig6_ThiessenPolygons_BaP.mxd DATE: 7/28/2014 1:52:26 PM



LOCATION	ARSENIC (mg/kg)
A1-10	10
A1-11	36.4
A1-12	14.5
A1-13	13.9
A1-14	20.9
A1-15	12.2
A1-16	14.4
A1-17	26.5
A1-19	4.2
A1-20	8.5
A1-21	16
A1-22	10.5
A1-23	18.6
A1-24	14.3
A1-25	12.5
A1-26	7.5
A1-27	13.8
A1-28	12.5
A1-29	10.3 [7.8]
A1-3	10.2
A1-30	8.8
A1-31	32.8
A1-32	10.8 [10]
A1-33	11.7
A1-34	9.5
A1-35	10.5
A1-36	13.5
A1-37	9
A1-38	9.3
A1-39	5.2
A1-40	10.3

LOCATION	ARSENIC (mg/kg)
A1-41	11.5
A1-42	8.7
A1-44	11.6 [14.1]
A1-45	12
A1-46	6.5
A1-47	17.6
A1-48	8.4
A1-6	32.7
A1-7	11.1
A1-9	23.3
A2-13	12.1 [12.6]
A2-14	14.8
A2-15	63.8
A2-16	44.4
A2-17	25.2
A2-18	13.8
A2-19	50.4 [35.8]
A3-18	6
A3-19	14.2
A3-20	11 [10.8]
A3-21	43.2
A3-22	9.9
A3-23	14.1
A3-24	19
FPT1-33%L	6.3
FPT1-33%R	5 J
FPT1-5'L	7.4 J
FPT1-5'R	7.1 J
FPT2-33%L	8.1
FPT2-33%R	8.3
FPT2-5'L	11.6

LOCATION	ARSENIC (mg/kg)
FPT2-5'R	6.9
FPT3-33%L	6.7
FPT3-33%R	9.9
FPT3-5'L	8.5
FPT3-5'R	7.3
FPT4-33%L	9
FPT4-33%R	7.9
FPT4-5'L	6.8
FPT4-5'R	6.5
FPT5-33%L	5.8
FPT5-33%R	10.7
FPT5-5'L	6.5
FPT5-5'R	10.2
NPL	9.6
SDD-1	21.5
SDD-12-15LB	12.8
SDD-12-15RB	17.6
SDD-12A	37.6 J
SDD-12-TLB	18 J
SDD-12-TRB	21
SDD-15	32
SDD-15-15LB	10.1
SDD-15-15RB	25.8
SDD-15-TLB	22.4
SDD-15-TRB	25.3 [23.2]
SDD-16	8
SDD-1-SPL	7.6
SDD-1-TLB	6.7
SDD-1-TRB	1.9 [3.5]
SDD-20A	18.7 J
SDD-20-TLB	8 J [6.9 J]

LOCATION	ARSENIC (mg/kg)
SDD-20-TRB	8.8
SDD-26	38.2
SDD-26-15N	28.9 [23.8]
SDD-26-15S	23 J [13.4 J]
SDD-27	23.5
SDD-28	25.1
SDD-28-15LB	16.4
SDD-28-TLB	16.2
SDD-28-TRB	6.3
SDD-29	26.5
SDD-29-15LB	29.9
SDD-29-15RB	1.1
SDD-29-TLB	26.8
SDD-29-TRB	22.6
SDD-32	13.5 J
SDD-33	27.8
SDD-34	8.3
SDD-35	36.4
SDD-36	18.2
SDD-37	10.3 [10.3]
SDD-4-15LB	7.6
SDD-4A	11.4
SDD-4-TLB	13.3
SDD-4-TRB	4.3
SDD-7	15.6
SDD-7-15LB	10
SDD-7-TLB	18.5
SDD-7-TRB	9.3
SDD-9	13.5
SDD-9-TRB	32.5

LEGEND:

ARSENIC (mg/kg)

- ≤ 7
- 7 - 11
- 11 - 16
- 16 - 26
- 26 - 40
- > 40
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 600 1,200

SCALE IN FEET

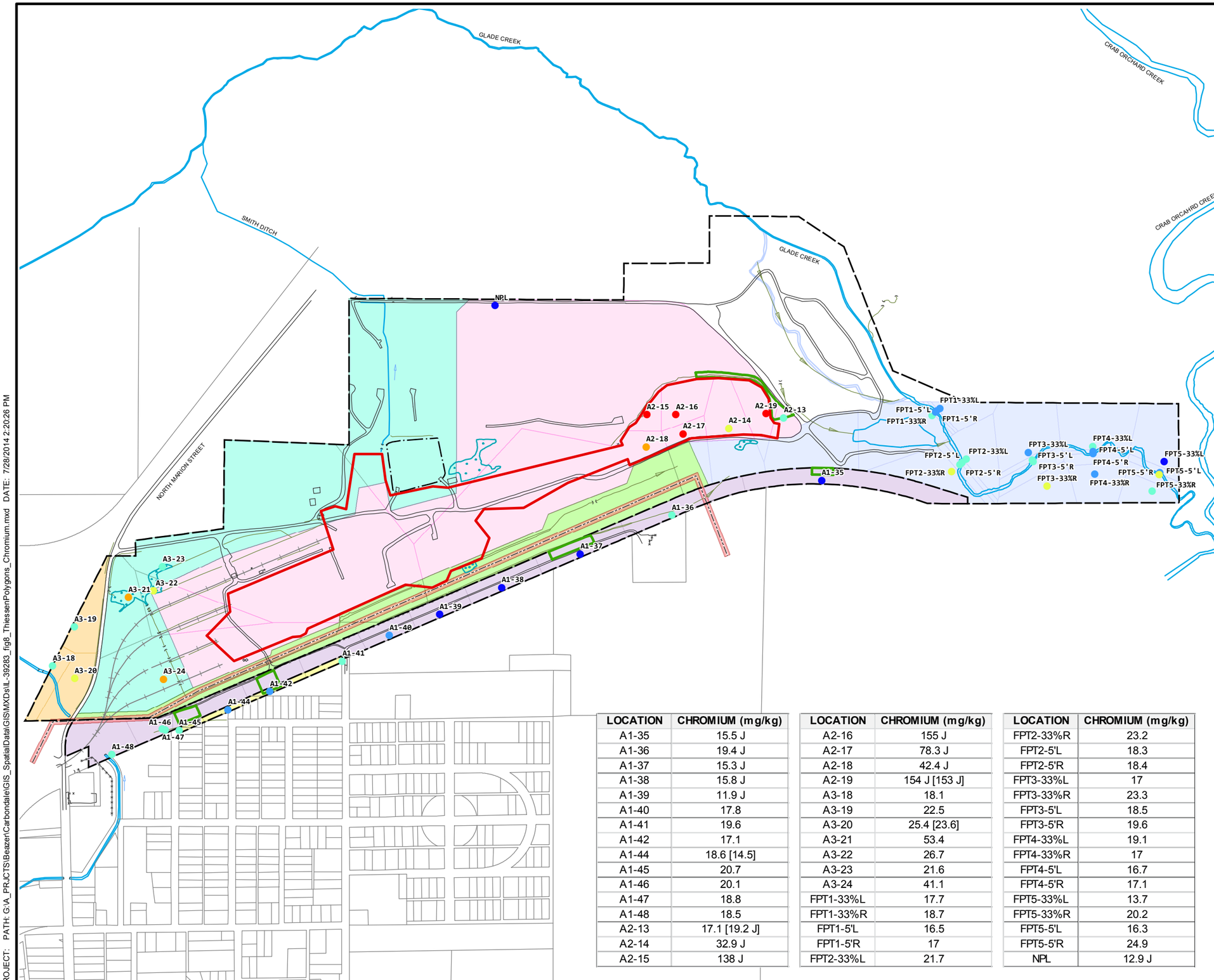
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

ARSENIC THIESSEN POLYGON MAP

ARCADIS

FIGURE 7

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\Beazer\Carbondale\GIS_Spatial\Data\GIS\MXDs\IL-39283_fig7_ThiessenPolygons_Ars.mxd DATE: 7/25/2014 3:48:21 PM



LOCATION	CHROMIUM (mg/kg)
A1-35	15.5 J
A1-36	19.4 J
A1-37	15.3 J
A1-38	15.8 J
A1-39	11.9 J
A1-40	17.8
A1-41	19.6
A1-42	17.1
A1-44	18.6 [14.5]
A1-45	20.7
A1-46	20.1
A1-47	18.8
A1-48	18.5
A2-13	17.1 [19.2 J]
A2-14	32.9 J
A2-15	138 J

LOCATION	CHROMIUM (mg/kg)
A2-16	155 J
A2-17	78.3 J
A2-18	42.4 J
A2-19	154 J [153 J]
A3-18	18.1
A3-19	22.5
A3-20	25.4 [23.6]
A3-21	53.4
A3-22	26.7
A3-23	21.6
A3-24	41.1
FPT1-33%L	17.7
FPT1-33%R	18.7
FPT1-5'L	16.5
FPT1-5'R	17
FPT2-33%L	21.7

LOCATION	CHROMIUM (mg/kg)
FPT2-33%R	23.2
FPT2-5'L	18.3
FPT2-5'R	18.4
FPT3-33%L	17
FPT3-33%R	23.3
FPT3-5'L	18.5
FPT3-5'R	19.6
FPT4-33%L	19.1
FPT4-33%R	17
FPT4-5'L	16.7
FPT4-5'R	17.1
FPT5-33%L	13.7
FPT5-33%R	20.2
FPT5-5'L	16.3
FPT5-5'R	24.9
NPL	12.9 J

LEGEND:

CHROMIUM (mg/kg)

- ≤ 16
- 16 - 18
- 18 - 23
- 23 - 36
- 36 - 68
- > 68

- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

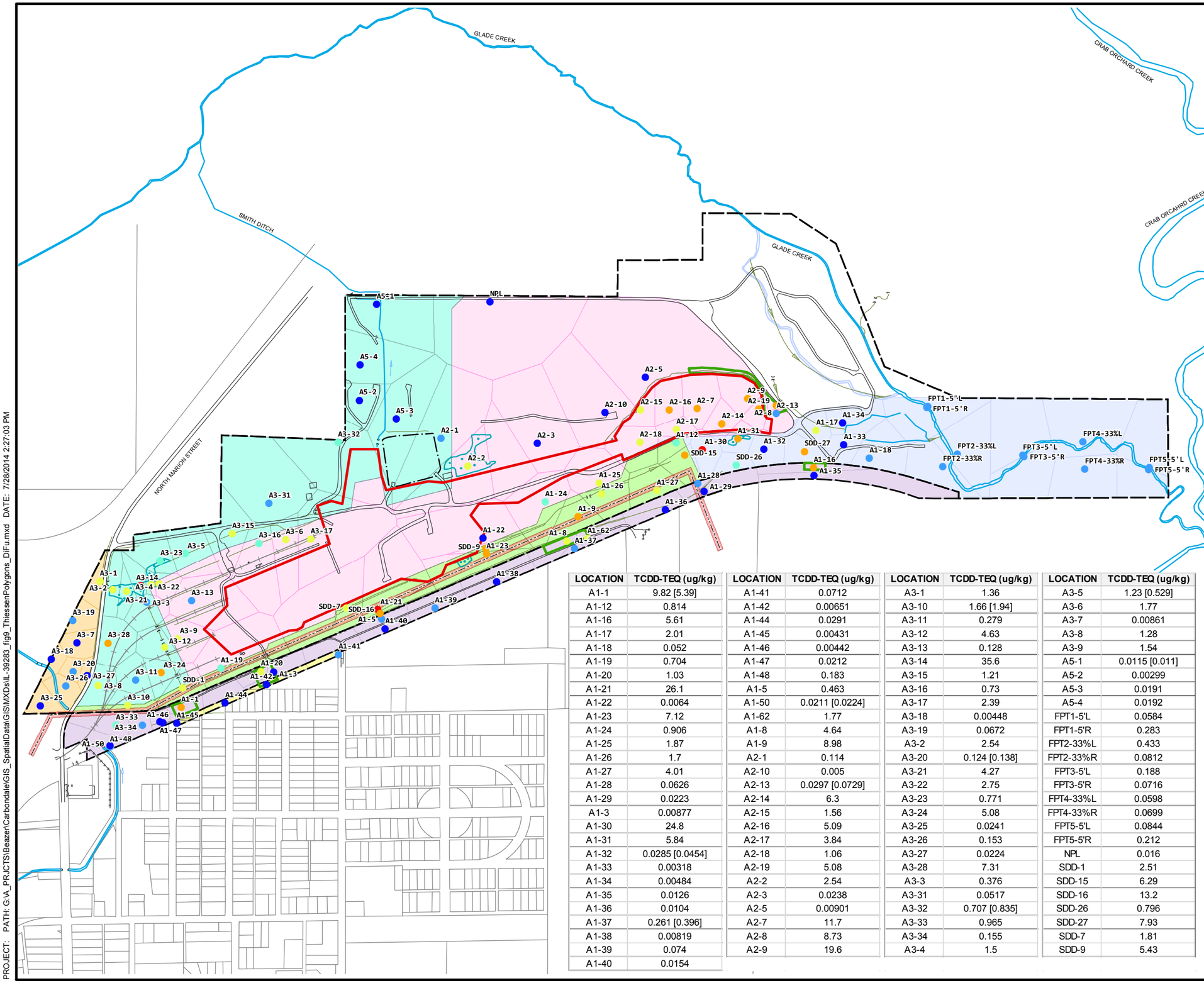
BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

CHROMIUM THIESSEN POLYGON MAP

ARCADIS

FIGURE 8

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PROJCTS\Beazer\Carbondale\GIS_Spatial\Data\GIS\MXDs\IL-39283_fig8_ThiessenPolygons_Chromium.mxd DATE: 7/28/2014 2:20:26 PM



LOCATION	TCDD-TEQ (ug/kg)	LOCATION	TCDD-TEQ (ug/kg)	LOCATION	TCDD-TEQ (ug/kg)	LOCATION	TCDD-TEQ (ug/kg)
A1-1	9.82 [5.39]	A1-41	0.0712	A3-1	1.36	A3-5	1.23 [0.529]
A1-12	0.814	A1-42	0.00651	A3-10	1.66 [1.94]	A3-6	1.77
A1-16	5.61	A1-44	0.0291	A3-11	0.279	A3-7	0.00861
A1-17	2.01	A1-45	0.00431	A3-12	4.63	A3-8	1.28
A1-18	0.052	A1-46	0.00442	A3-13	0.128	A3-9	1.54
A1-19	0.704	A1-47	0.0212	A3-14	35.6	A5-1	0.0115 [0.011]
A1-20	1.03	A1-48	0.183	A3-15	1.21	A5-2	0.00299
A1-21	26.1	A1-5	0.463	A3-16	0.73	A5-3	0.0191
A1-22	0.0064	A1-50	0.0211 [0.0224]	A3-17	2.39	A5-4	0.0192
A1-23	7.12	A1-62	1.77	A3-18	0.00448	FPT1-5'L	0.0584
A1-24	0.906	A1-8	4.64	A3-19	0.0672	FPT1-5'R	0.283
A1-25	1.87	A1-9	8.98	A3-2	2.54	FPT2-33%L	0.433
A1-26	1.7	A2-1	0.114	A3-20	0.124 [0.138]	FPT2-33%R	0.0812
A1-27	4.01	A2-10	0.005	A3-21	4.27	FPT3-5'L	0.188
A1-28	0.0626	A2-13	0.0297 [0.0729]	A3-22	2.75	FPT3-5'R	0.0716
A1-29	0.0223	A2-14	6.3	A3-23	0.771	FPT4-33%L	0.0598
A1-3	0.00877	A2-15	1.56	A3-24	5.08	FPT4-33%R	0.0699
A1-30	24.8	A2-16	5.09	A3-25	0.0241	FPT5-5'L	0.0844
A1-31	5.84	A2-17	3.84	A3-26	0.153	FPT5-5'R	0.212
A1-32	0.0285 [0.0454]	A2-18	1.06	A3-27	0.0224	NPL	0.016
A1-33	0.00318	A2-19	5.08	A3-28	7.31	SDD-1	2.51
A1-34	0.00484	A2-2	2.54	A3-3	0.376	SDD-15	6.29
A1-35	0.0126	A2-3	0.0238	A3-31	0.0517	SDD-16	13.2
A1-36	0.0104	A2-5	0.00901	A3-32	0.707 [0.835]	SDD-26	0.796
A1-37	0.261 [0.396]	A2-7	11.7	A3-33	0.965	SDD-27	7.93
A1-38	0.00819	A2-8	8.73	A3-34	0.155	SDD-7	1.81
A1-39	0.074	A2-9	19.6	A3-4	1.5	SDD-9	5.43
A1-40	0.0154						

LEGEND:

TCDD-TEQ (ug/kg)

- ≤ 0.05
- 0.05 - 0.7
- 0.7 - 1
- 1 - 5
- 5 - 20
- > 20
- GLADE CREEK OLD LOCATION
- RIVER/CREEK
- DRAINAGE DITCH
- WETLAND
- CAMU CONTAINMENT AREA
- ABANDONED RAILROAD
- SITE FEATURES
- FENCE
- OFF-SITE PROPERTY
- POTENTIAL BIKE PATH
- PROPERTY BOUNDARY
- POTENTIAL BIKE PATH LOCATION
- WESTERN CONSERVATION EXPOSURE AREA
- CENTRAL CONSERVATION EXPOSURE AREA
- PROPOSED SOLAR USE AREAS
- SOUTHERN CONSERVATION EXPOSURE AREA
- EASTERN CONSERVATION EXPOSURE AREA
- RAILROAD PROPERTY EXPOSURE AREA
- 35' SWATH EXPOSURE AREA
- SOIL CAP
- SOIL REMOVAL AREA

0 630 1,260

SCALE IN FEET

BEAZER EAST, INC.
FORMER KOPPERS WOOD-TREATING SITE
CARBONDALE, ILLINOIS

DIOXIN-FURAN THIESSEN POLYGON MAP

ARCADIS

FIGURE 9

CITY: CHELMSFORD DIV/GROUP: ENV/IEST DB: mbuonanduci LD: PIC: PM: TM:
PROJECT: PATH: G:\A_PRJCTS\BeazerCarbondale\GIS_Spatial\data\GIS\MXDs\IL-39283_fig9_ThiessenPolygons_DiFu.mxd DATE: 7/28/2014 2:27:03 PM

Attachment 1

1. Deer Ingestion Rate

On behalf of Beazer East, Inc. (Beazer), ARCADIS U.S. Inc. (ARCADIS) has prepared this Technical Memorandum presenting the deer ingestion rates to be used in the Human Health Risk Assessment (HHRA) for the Former Koppers Wood-Treating Site (Site) located in Carbondale, Illinois.

The HHRA for the Site includes a hypothetical scenario under which a family harvests and consumes deer that have foraged at the Site. Ingestion rates for wild caught meat are not available from the Exposure Factors Handbook (USEPA 2011). This Attachment presents the derivation of the deer ingestion rates presented in Table 11 of the HHRA Work Plan.

First, the number of deer potentially harvested from the Site was estimated based on data presented in the Summary of 2012-2013 Illinois Deer Seasons (IDNR 2013). Dividing the number of deer harvested in Jackson County, which includes Carbondale, by the number of acres of Jackson County produces a rate of 0.0082 deer harvested per acre. This correlates to an estimated average harvest of 1.5 deer per year from the 187-acre Site.

Second, using a mean deer weight of 56.5 kilograms from Sample (1994) and a meat yield from a buck of 40% (http://www.butcher-packer.com/index.php?main_page=document_general_info&products_id=331), the Site could potentially yield 34.8 kg of edible meat per year or 95.5 grams per day.

Third, the hypothetical total of 95.5 grams per day was conservatively distributed among a single family of four people representing three different age groups; two adults, one adolescent, and one child, by assuming the same distribution of ingestion rates for the each age group (adult, adolescent, and child) as is presented for total meat ingestion in the 2011 Exposure Factors Handbook (USEPA 2011). The resulting deer ingestion rates are 28.1, 25.0 and 14.2 grams per day, for adults, adolescent and child, respectively (Table 11 of the HHRA WP).

Concentrations of COPCs in deer meat will be estimated using uptake equations found in USEPA's Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities (USEPA 2005). Equations used to model uptake from soil to beef will be used to model deer meat concentrations. COPCs in soil are assumed to be consumed by the deer both through the plants that make up their diet and through direct ingestion of soil that may be on the plants they digest.

As presented in the Work Plan, COPC concentrations in the plants in a deer's diet will be calculated as follows:

$$C_{plant} = C_{soil} \times Br$$

where:

C_{plant}	=	Chemical Concentration in Plants Due to Root Uptake (mg/kg dry weight);
C_{soil}	=	Chemical Concentration in Soil (mg/kg); and
Br	=	Plant-Soil Bioconcentration Factor (unitless).

Additionally, COPC concentrations in deer meat will be calculated as follows:

$$C_{deer} = ((F \times Q_{plant} \times C_{plant}) + Q_{soil} \times C_{soil} \times B_{soil}) \times Ba_{deer}$$

where:

C_{deer}	=	Chemical Concentration in Deer (mg/kg dry weight);
F	=	Fraction of Plant Grown on Site Soil and Ingested by the Deer (unitless);
Q_{plant}	=	Quantity of Plant Ingested by the Deer per Day (kg DW/d);
C_{plant}	=	Chemical Concentration in Plants (mg/kg dry weight);
Q_{soil}	=	Quantity of Soil Ingested by the Deer per Day (kg DW/d);
C_{soil}	=	Chemical Concentration in Soil (mg/kg);
B_{soil}	=	Soil Bioavailability Factor (unitless); and
Ba_{deer}	=	Biotransfer Factor for Deer (beef used as a surrogate) (mg/kg fresh weight).

The deer will be assumed to have a food ingestion rate of 1.74 kg wet weight per day (Sample, 1994) and a soil ingestion rate of 2% of the food ingestion (Sample, 1994).

2. References

IDNR 2013. Summary of 2012-2013 Illinois Deer Seasons. Forest Wildlife Program, Illinois Department of Natural Resources. http://www.dnr.illinois.gov/hunting/deer/Documents/IllinoisDeerHarvestReportFinal.2012.2013.pdf

Sample, 1994. Estimating Exposure of Terrestrial Wildlife to Contaminants. Environmental Sciences Division. Oak Ridge National Laboratory, Oak Ridge, Tennessee. B.E. Sample and G.W. Suter II. ES/ER/TM-125. September 1994.

USEPA 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. September 2005. Office of Solid Waste and Emergency Response. EPA530-R-05-006.

USEPA 2011. Exposure Factors Handbook: 2011 Edition. EPA/600/R-09/052F. Office of Research and Development. National Center for Environmental Assessment, Washington, DC. September 2011.

Attachment 2

1. Application of Thiessen Polygons

On behalf of Beazer East, Inc. (Beazer), ARCADIS U.S. Inc. (ARCADIS) has prepared this Attachment presenting the application of Theissen polygons to be used in the Human Health Risk Assessment (HHRA) (and ecological risk assessment) for the Former Koppers Wood-Treating Site (Site) located in Carbondale, Illinois.

Exposure Point Concentrations (EPCs) for COPCs in on-Site surface soil and off-Site surface soil in the railroad property and the 35' swath of Beazer-owned property to the south will be estimated using spatially-weighted 95th percentile upper confidence limits (UCLs) on the mean to account for the varying densities of sampling locations on different parts of the Site. Spatially-weighted 95th UCLs for each exposure area will be calculated using Thiessen polygons, which are a common geostatistical approach for representing the data points of non-equal portions of an area. Geostatistical methods have been researched, used, and endorsed by USEPA for approximately the past two decades. The usefulness of geostatistical tools to help overcome variation in sampling distribution is described in several USEPA documents published over the past twenty years (Breckenridge et al, 1991; USEPA, 2001). USEPA began research into geostatistical methods around 1985, and has developed its own geostatistical software tools including GEO-PACK and GEO-EAS, which became available in 1990 and 1991, respectively (USEPA, 1990; USEPA, 1991). Perhaps most notably, risk assessment guidance published by USEPA includes use of geostatistical methods to improve data analysis and to help determine the EPC.

The Thiessen polygon technique was selected as the most appropriate spatial tool because it captures the representativeness of the sampling locations across the evaluated area without any biases that may be introduced by more complex interpolative geospatial tools such as Kriging or splining.

The Thiessen polygon geostatistical approach involves using software (for example, ArcGIS) to draw polygons within an overall area of interest (e.g., the Site) so that each polygon contains one sample point, and the area within that polygon is closer to that point than it is to any other sample location. All soil within a polygon is then assumed to have the same concentration as that polygon's sample point. This approach reflects the underlying assumption that the concentration of a COPC in soil can be represented by the sample point closest to that location. However, in certain instances, hard boundaries are used to constrain polygon boundaries when a site feature precludes the expectation that soil in a given area is represented by the closest sample point. For example, the following constraints will be used when developing polygon boundaries for the Site:

a. North Marion Street will be established as a hard boundary between polygons associated with samples to the west of the road and those to the east of the road. This is based on the expectation that the road is a physical boundary that would preclude the expectation that sample points on one side of the road would be representative of soils on the other side of the

road given the road's physical features and the differing nature of historical operations on one side versus the other;

b. The former North Drainage Ditch will be established as a hard boundary for polygons associated with sample points collected from the former lagoon area. This is based on the North Drainage Ditch being a highly incised drainage feature in this area. The presence of this feature, combined with the substantially different use histories between the areas south (former lagoon) and north (farm field and borrow pit) of the channel, precludes the expectation that samples from the former lagoon would be representative of soil in the farm field and borrow pit; and

c. The boundaries between the railroad property exposure area to the south of the Site and the southern property lines of the Site will be established as a hard boundary. This is based on the Site's southern property boundary having been defined as the southern limit of potential ecological exposures associated with the Southern Exposure area at the direction of the USEPA. However, potential human exposures were identified for the railroad property and the 35' swath of Beazer-owned property to the south. A separate set of polygons was established to support the human health risk assessment for the railroad and Beazer-owned properties to the south. Use of the southern property line as a hard boundary is not intended to imply that a physical barrier exists at the property line. Rather, it simply precluded the need for two sets of varying polygons in the Southern Exposure area (i.e., one set supporting the human health risk assessment that includes the railroad property and a second supporting the ecological risk assessment only for the Southern Exposure Area).

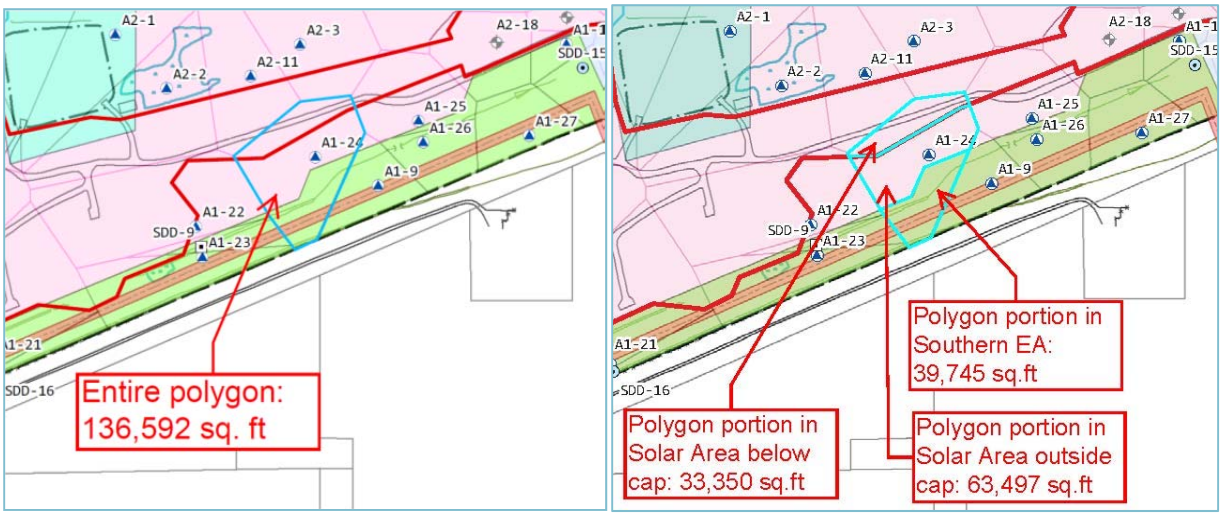
A spatially weighted 95th UCL EPC for any given exposure area will be calculated by considering the fraction of the total exposure area that each individual polygon represents. This spatially weighted 95th UCL concentration represents a central tendency estimate of the exposure point concentration in the exposure area.

Not all COPCs were analyzed in every sample; therefore, Thiessen polygons were drawn for each COPC. Accordingly, the polygons and calculations differ slightly between COPCs depending on the dataset.

Exposure area boundaries were then overlaid on the Thiessen polygons. This overlaying of the exposure area boundaries on the existing polygons resulted in some polygons being divided between two exposure areas. In other words, a portion of some polygons falls within one exposure area and the remainder falls within another exposure area. In such cases, each portion of the polygon was treated as any other polygon in the respective exposure areas and was assumed to have a concentration equal to that of the original polygon when estimating the spatially weighted EPC for that exposure area (i.e., the upper 95th percentile of the distribution of spatially weighted arithmetic means). This process is illustrated below for

the dioxin data at the polygon associated with sample location A1-24 that is located in the former process area east-southeast of the CAMU, as shown on attached Figure 1.

Sample location A1-24 has an associated TCDD TEQ concentration of 906 ppt. The polygon associated with this sample point includes portions that fall within the existing surface cover of the Proposed Solar Use Area, uncovered portions of the Proposed Solar Use Area, and the Southern Exposure Area. The area and boundaries associated with each portion of the polygon are shown in the following excerpts:



For the portion of this polygon that falls within the surface cover (33,350 ft^2), the process assumes a concentration of "0" because a clean soil cover presently exists in this area. When evaluating this polygon's contribution to the overall Site-wide concentration, the remaining area of the polygon (103,242 ft^2) was assigned a TCDD TEQ of 906 ppt.

2. References

Breckenridge, R. P., Williams, J. R., and Keck, J. F. 1991. Characterizing Soils for Hazardous Waste Site Assessments. Ground-Water Issue, EPA/540/4-91/003, Office of Research and Development, Office of Solid Waste and Emergency Response.

Singh, A.K., A. Singh, and M. Engelhardt. 1997. The Lognormal Distribution in Environmental Applications. EPA/600/R-97/006. December 1997.USEPA. 1990. Geostatistics For Waste Management: User's Manual For the GEOPACK(Version 1.0), Geostatistical Software System. EPA/600/8-90/004, January, 1990. http://www.epa.gov/ada/download/models/geopack.pdf

USEPA. 1991. GEO-EAS 1.2.1. Geostatistical Environmental Assessment Software. User's Guide. EPA 600/4-88/033, March, 1991. http://www.epa.gov/ada/download/models/geoeas.pdf

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume III - Part A, Process for Conducting Probabilistic Risk Assessment. EPA 540-R-02-002, OSWER 9285.7-45. December. Office of Emergency and Remedial Response. [http://www.epa.gov/oswer/riskassessment/rags3adt/pdf/rags3adt_complete.pdf]

USEPA. 2002. Guidance on the Calculation of Upper Confidence Limits for Exposure Point Concentrations at Superfund Sites. DRAFT. May. Office of Emergency and Remedial Response.