

DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99
Revised 9/20/02

RCRA Corrective Action
Environmental Indicator (EI) RCRA Info code (CA725)
Current Human Exposures Under Control

Facility Name: Browning-Ferris Industries
Facility Address: 8501 Stillhouse Rd, Liberty, Missouri, 64068
Facility EPA ID #: MOD000624452

DETERMINATION RESULT: YE

1. Has all available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

If yes - check here and continue with #2 below.

If no - re-evaluate existing data, or

if data are not available skip to #6 and enter "IN" (more information needed) status code.

The Browning-Ferris Industries (BFI) landfill is located on about 200 acres in Missouri City, Missouri (see Figure 1). BFI constructed the facility as a municipal landfill in 1972, added hazardous waste streams in 1974, and began closure of the landfill in 1983 (Earth Sciences Consultants [ESC] 1992). Hazardous waste management at the facility included disposal of bulk dry sludges and containerized industrial waste, and solidification and disposal of bulk liquid sludges (ESC 1992).

The BFI facility has been monitored and investigated since at least 1983, when routine off-site monitoring of three groundwater locations began (ESC 1992). BFI completed approved closure and submitted a revised postclosure permit application in 1988 (ESC 1992). In 1989, the facility entered into an Administrative Order on Consent (AOC) with the U.S. Environmental Protection Agency (EPA). The AOC required the facility to conduct a RCRA facility investigation (RFI) to determine the nature and extent of releases from eight solid-waste management units (SWMU) at the facility (ESC 1992) (see Figure 2). The RFI, including sampling of groundwater, soil, sediment, and surface water, was completed in 1992 (ESC 1992).

At the time of the RFI, several corrective measures were already in place at the facility, but the final corrective measures study (CMS) was completed in 1995. Corrective measures at the facility include (ESC 1995):

- *A multicomponent cap.* The cap consisted of a 18- to 24-inch layer of compacted soil overlain by a 20-mil polyvinyl chloride membrane, a geonet drainage layer, 2 feet of soil and vegetative cover, and drainage structures.

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- *A groundwater interceptor trench.* The trench was designed to intercept groundwater from the Winterset Limestone. Groundwater is captured by the trench, directed to three sumps, and transported off site to a treatment facility.
- *An active gas collection and destruction system.* The gas extraction and destruction system consists of 23 gas recovery wells, a blower system, and a gas flare.
- *A leachate collection system.* Leachate is collected from the areas of the sludge trenches, the chemical landfill, and Trench D.
- *Purchase of adjacent property to the south and west.* BFI purchased properties adjacent to the facility to limit access to areas of potential contamination.
- *Facility security.* Security measures include a three-strand, barbed wire, 4-foot-high fence that surrounds the entire facility; gates that are locked when the site is unattended; posted "Danger – Unauthorized Personnel Keep Out" signs; and locks on all wells, system equipment, and system buildings.

In addition, a seep interceptor trench was installed in 1996 to intercept contaminated groundwater (ESC 1996). The final remedy decision, issued by EPA in 2000, required continued operation and maintenance of these measures and added a requirement for institutional controls (EPA 2000).

The primary contaminants released to soil, groundwater, sediment, and surface water from BFI's SWMUs are metals; chlorinated and petroleum-derived volatile organic compounds (VOC); pesticides; and herbicides (Herst & Associates [Herst] 2002b, 2004a, 2004b). Semivolatile organic compounds (SVOC) also have been detected in a limited number of locations at the facility (Herst 2002b, 2004a, 2004b).

The following SWMUs were investigated during the RFI. The French drain area of concern was identified during investigations in 2002. All are shown on Figure 2.

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Sanitary Landfill. This SWMU operated from 1972 until 1983. Although it was originally constructed as a sanitary landfill, BFI accepted some industrial wastes at this SWMU until 1974. After 1974, industrial wastes were segregated, processed, and disposed of in separate facilities (ESC 1992). During closure, the landfill was covered with a multicomponent cap and vegetation (ESC 1992).

Sludge Trenches. This SWMU was used to dispose of solid wastes. Trenches 1, 2, A, C, D, and E were used for disposal of industrial sludges, as approved by Missouri Department of Natural Resources (MDNR) (ESC 1992). Trench 3 was used to dispose of manganese dioxide. Trenches 1, 2, D, and E were constructed with leachate collection systems (ESC 1992). During closure, the trenches were covered with a multicomponent cap and vegetation (ESC 1992).

Sludge Drying Beds. This SWMU, which operated from 1977 to 1978, was used to separate solids from bulk liquid sludges (ESC 1992). The only waste received at this SWMU was nonhazardous biotreater waste from a petroleum refinery. Liquids were filtered and directed to the Chemical Processing Center (CPC), and the remaining sludges were landfilled in the sludge trenches (ESC 1992). During closure, the trenches were covered with a multicomponent cap and vegetation (ESC 1992).

Chemical Landfill. This SWMU was used to dispose of chemical waste, including containerized hazardous waste approved by MDNR. The landfill was constructed with leachate collection system. During closure, the SWMU was covered with 2 feet of compacted clay and 1 foot of topsoil, and the eastern portion of the SWMU was covered with treated waste from the CPC. The entire SWMU was then covered with a multicomponent cap (ESC 1992).

Chemical Processing Center. This SWMU, also known as the Liquid Reception Center, consisted of a tank farm, three clay-lined surface impoundments, and two processing units (ESC 1992). The tank farm included three railroad tank cars (each 8,700 gallons), two upright tanks (each 10,000 gallons) and four open concrete tanks (each 6,000 gallons). During closure, the impoundments were backfilled with uncontaminated on-site soil and then capped with a multicomponent cap (ESC 1992).

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Wastewater Treatment Pond. This SWMU was a small oxidation pond south of Trench D, which collected contaminated groundwater from a hand-dug cistern; the location is not shown on any available figures (ESC 1992). The pond was used to separate floating oil and remove trace VOCs in the groundwater (ESC 1992). At closure, all waste and contaminated soil was removed, the pond backfilled with uncontaminated soil, and a multicomponent cap was installed (ESC 1992).

Gelation Basins. This SWMU, which included two basins (old and new), was used to dispose of treated waste from the CPC (ESC 1992). Slurry was spread out in the basin and would solidify within two to three weeks (ESC 1992). At closure, the basins were equipped with fluid collection systems and covered with a multicomponent cap (ESC 1992).

Stormwater Retention Pond. This SWMU, also identified as the Temporary Stormwater Retention Basin, was constructed in 1982 to collect stormwater from the gelation basins (ESC 1992). At closure, it was backfilled with uncontaminated soil and capped with a multicomponent cap (ESC 1992).

French Drain. This area of concern was identified in 2002. During groundwater sampling, workers observed a pipe exiting into the groundwater interceptor trench (Herst 2003b). According to interviews with site personnel, the pipe was the outlet of a French drain installed in 1996 when the groundwater interceptor trench was installed (Herst 2003b). Based on the area drained (the area around well cluster P-5), this area of concern was not believed to be the source or migration pathway for contaminants (Herst 2003b).

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of “Current Human Exposures Under Control” EI

A positive “Current Human Exposures Under Control” EI determination (“YE” status code) indicates that there are no “unacceptable” human exposures to “contamination” (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all “contamination” subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The “Current Human Exposures Under Control” EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program’s overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

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Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRA Info national database ONLY as long as they remain true (i.e., RCRA Info status codes must be changed when the regulatory authorities become aware of contrary information).

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2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **“contaminated”**¹ above appropriately protective risk-based “levels” (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria [e.g., Maximum Contaminant Levels (MCLs), the maximum permissible level of a contaminant in water delivered to any user of a public water system under the Safe Drinking Water Act] from releases subject to RCRA Corrective Action (from SWMUs, RUs, or AOCs)?)

Media	Yes	No	?	Rationale/Key Contaminants
Groundwater	X			
Air (indoors) ²		X		
Surface Soil (e.g., <2 ft)		X		
Surface Water	X			See below for details
Sediment		X		
Subsurf. Soil (e.g., >2 ft)	X			
Air (outdoors)		X		

_____ If no (for all media) - skip to #6, and enter “YE,” status code after providing or citing appropriate “levels,” and referencing sufficient supporting documentation demonstrating that these “levels” are not exceeded.

 X If yes (for any media) - continue after identifying key contaminants in each “contaminated” medium, citing appropriate “levels” (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

_____ If unknown (for any media) - skip to #6 and enter “IN” status code.

Rationale and Reference(s):

The BFI facility is located on about 200 acres in Missouri City, Missouri, about 1 mile north of the Missouri River (ESC 1992; Herst 2003b). The area used for waste management occupies about 90 acres in the southern part of the property; the northern 110 acres are undeveloped or have been used as a soil borrow area during closure (ESC 1992). The land surrounding the BFI facility is primarily agricultural, with some light industry along the Missouri River and low-density residential use to the south and west; a wildlife preserve is about 2.5 miles east of site (ESC 1992). The facility is fenced on all sides (ESC 1995). The facility is about 1 mile north of Missouri City, Missouri, which has a population of about 300 (U.S. Census 2004).

¹ “Contamination” and “contaminated” describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based “levels” (for the media, that identify risks within the acceptable risk range).

²Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

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The BFI facility lies above the flood plain of the Missouri River on a drainage divide (Center for Agricultural, Resource, and Environmental Systems [CARES] 2004). Most of the facility drains east, toward the Missouri River floodplain, but the southwest corner drains directly south, into the Missouri River by an unnamed intermittent tributary (ESC 1992). As part of the facility closure, a surface water management system was constructed over the landfill cap. This system drains into two outfalls east and northeast of the landfill (locations S-1 and S-2) (ESC 1992). The surface water drainages are intermittent and are often dry during sampling events (Herst [2001a](#), [2002a](#), [2003a](#), [2004a](#), [2004b](#); EPA [2004](#)). In addition to the intermittent streams, several ponds also receive runoff from the facility. BFI purchased three ponds that collected surface water runoff from the southern parts of the facility; one pond was eliminated by construction of a new highway (ESC 1992). The facility conducts routine off-site surface water monitoring at seven locations (ESC 1992).

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The surficial geology of the site consists of Quaternary unconsolidated materials overlying interbedded Pennsylvanian-age limestones and shales. Unconsolidated materials at the site consist of soil, loess, and glacially-derived materials; the unit ranges in thickness from 17 to 20 feet (ESC 1992). From top to bottom, the bedrock units underlying the unconsolidated material are (ESC 1992):

- The Winterset Limestone (averaging 35 feet thick)
- The Stark/Galesburg Shales (from 2 to 6.5 feet thick)
- The Bethany Falls Limestone (from 25 to 34 feet thick)
- The Hushpuckney Shale (from 2 to 3 feet thick)
- Units of the Lower Kansas City Group and Upper Pleasanton Group.

Site hydrogeology is dominated by fracture flow through limestone and weathered shale. The groundwater zones monitored at the facility are the soil zone (well suffix L), Winterset Limestone (well suffix W), Bethany Falls Limestone (well suffix F), and the Lower Kansas City/Upper Pleasanton Group (well suffix K) (ESC 1992). In general, wells screened only in the soil zone are dry, and the zone is not considered a water-bearing unit at the site (Herst [2004a](#)). Groundwater in the Winterset Limestone flows along the base of the unit or in the fractured surface of the underlying Stark/Galesburg Shale. The unit has a linear groundwater high in the western part of property, and groundwater flows away to the east and west (Herst [2004a](#)) (see Figure 3). Seeps issuing from the base of the Winterset are SS-1, SS-2, SS-8, and SS-9 (ESC 1992). Groundwater in the Bethany Falls Limestone flows along the base of the unit or in the fractured surface of the underlying Hushpuckney Shale. The unit has a linear groundwater high in the western part of property, and groundwater flows away to the east and west; the unit also has a persistent high in the area of well P-18F (see Figure 4). Groundwater in the Lower Kansas City/Upper Pleasanton Group flows east, although no wells are completed in this unit in the western part of the property (see Figure 5).

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Groundwater

Groundwater samples at the BFI facility have been collected since 1983, when routine off-site monitoring of three groundwater locations began (ESC 1992). The facility currently monitors 47 monitoring wells on-site, 3 groundwater discharge locations offsite (WCON, WKIN, WCOY), 5 seeps on-site, 3 sumps associated with the groundwater interceptor trench, and 1 sump associated with the seep collection trench (Herst [2004a](#)) (see Figure 2). The facility conducts routine quarterly monitoring for VOCs, cyanide, selected metals, organochlorine pesticides, chlorinated herbicides, and dioxin/furan compounds. Recently, the facility proposed changing the sampling frequency to semi-annual (Herst [2004a](#)).

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The most contaminated groundwater samples have been collected from wells screened in the Winterset and Bethany Falls units in the area south and east of the waste management units and from the sump of the groundwater interceptor trench, which collects groundwater from the Bethany Falls unit (SUMP-4). Table 1 shows the maximum concentrations of a selection of hazardous constituents in groundwater at the facility since 2000, including all detections that exceed EPA action levels, EPA maximum contaminant levels (MCL) or Region 9 preliminary remediation goals (PRG). Table 2 shows the maximum concentrations in the most recent sampling events. Since 2000, 27 compounds have been detected at concentrations that exceeded their EPA action levels, MCLs, or PRGs.

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In the first and second quarters of 2004, nine constituents were detected at concentrations that exceeded MCLs or PRGs: antimony (maximum of 6 micrograms per liter [$\mu\text{g/L}$]); arsenic (19 $\mu\text{g/L}$); benzene (12 $\mu\text{g/L}$); 1,1-dichloroethene (DCE) (9.5 $\mu\text{g/L}$); 1,2-dichloroethane (5.8 $\mu\text{g/L}$); 2,4,5-TP (640 $\mu\text{g/L}$); tetrachloroethene (PCE) (25 $\mu\text{g/L}$); trichloroethene (TCE) (21 $\mu\text{g/L}$); and vinyl chloride (45 $\mu\text{g/L}$).

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Table 1 - Maximum Concentrations of Constituents in Groundwater, 2000 to 2004

Compound of Concern	Relevant Standard or Criteria ($\mu\text{g/L}$)	Maximum Concentration Detected ($\mu\text{g/L}$)	Location of Maximum Concentration	Sampling Date	Other Wells above MCL or PRG (2000 to 2004)
Herbicides					
2,4,5-T	PRG, 360	0.73	Sludge Trench D	11/2000	
2,4,5-TP (Silvex)	MCL, 50	920	P-3W	2/2002	
Metals					
Antimony, dissolved	MCL, 6	18.9	P-10W	2/2001	P-1W, P-2F, P-5AF, P-18W, P-23K
Antimony, total	MCL, 6*	37.5	P-3W	11/2000	P-1W, P-5AF, P-10W, P-11W, P-15F, P-23K
Arsenic, dissolved	MCL, 10**	29.3	P-3W	2/2001	P-3L
Arsenic, total	MCL, 10*	28.6	P-15W	8/1999	P-3L, P-3W, P-10W, SS-2, SUMP-4
Barium, dissolved	MCL, 2,000	3,200	P-3W	11/2001	
Barium, total	MCL, 2,000	3,200	P-3W	2/2002	
Beryllium, total	MCL, 4*	2.06	P-10W	2/2000	
Cadmium, dissolved	MCL, 5	15.5	P-15W	2/2000	P-18W, P-20AF (S), P-21K, SS-12
Cadmium, total	MCL, 5*	442	P-15F	8/2001	P-1L, P-2F, P-3L, P-4F, P-4W, P-5AF, P-10W, P-13F, P-14F, P-14W, P-15L, P-15W, P-18F, P-18L, P-18W
Lead, total	Action Level, 15*	122	P-13F	8/1999	P-1L, P-1W, P-2F, P-3L, P-4F, P-5AF, P-10W, P-15F, P-15L, P-15W, P-16L, P-18L, P-20AF (S), P-22K
Pesticides					
Aldrin	PRG, 0.004	0.755	Sludge Trench D	11/2000	
Demeton	PRG, 1.5	40	SUMP-4	5/2003	
Disulfoton	PRG, 1.5	70	SUMP-4	5/2003	
Endosulfan	PRG, 220	2.19	SUMP-4	2/2001	
Lindane (gamma-BHC)	MCL, 0.2	6.81	SUMP-4	5/2000	SUMP-1
Naled	PRG, 73	18	SUMP-4	5/2003	
Phorate	PRG, 7.3	230	SUMP-4	11/2001	LM-4

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Table 1 - Maximum Concentrations of Constituents in Groundwater, 2000 to 2004

Compound of Concern	Relevant Standard or Criteria (µg/L)	Maximum Concentration Detected (µg/L)	Location of Maximum Concentration	Sampling Date	Other Wells above MCL or PRG (2000 to 2004)
<u>o,o,o-Triethyl-phosphorothioate</u> ***	<u>PRG, 220</u>	<u>2,700</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>LM-4</u>
Semivolatile Organic Compounds					
<u>2-Chlorophenol</u>	<u>PRG, 30</u>	<u>70</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>o-Cresol</u>	<u>PRG, 1,800</u>	<u>27.5</u>	<u>SUMP-4</u>	<u>5/2001</u>	
<u>Diethyl phthalate</u>	<u>PRG, 29,000</u>	<u>3,500</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>2,4-Dichlorophenol</u>	<u>PRG, 110</u>	<u>720 J</u>	<u>SUMP-4</u>	<u>11/2001</u>	
<u>bis(2-Ethylhexyl)phthalate</u>	<u>MCL, 6</u>	<u>207</u>	<u>SUMP-4</u>	<u>11/2000</u>	<u>Sludge Trench D, SUMP-3</u>
<u>Naphthalene</u>	<u>PRG, 6.2</u>	<u>200 J</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>2,4,5-Trichlorophenol</u>	<u>PRG, 3,600</u>	<u>3,200</u>	<u>SUMP-4</u>	<u>5/2003</u>	
Volatile Organic Compounds					
<u>Benzene</u>	<u>MCL, 5</u>	<u>310</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>P-1F, P-3L, P-3F, P-3W, SUMP-3</u>
<u>Chloroform</u>	<u>PRG, 6.2</u>	<u>240</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>P-3W, SUMP-1</u>
<u>Dibromochloromethane</u>	<u>PRG, 0.13</u>	<u>15</u>	<u>SUMP-1</u>	<u>11/2001</u>	
<u>Dichlorobromomethane</u>	<u>PRG, 0.18</u>	<u>22</u>	<u>SUMP-1</u>	<u>11/2001</u>	
<u>Dichlorodifluoromethane</u>	<u>PRG, 390</u>	<u>92</u>	<u>P-1L</u>	<u>11/2001</u>	
<u>1,1-Dichloroethane</u>	<u>PRG, 800</u>	<u>130</u>	<u>P-3W</u>	<u>11/2002</u>	
<u>1,2-Dichloroethane</u>	<u>MCL, 5</u>	<u>85</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>P-23K</u>
<u>1,1-Dichloroethene</u>	<u>MCL, 7</u>	<u>16</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>P-1L, P-3F</u>
<u>cis-1,2-Dichloroethene</u>	<u>MCL, 70</u>	<u>5,300</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>LM-4</u>
<u>Ethylbenzene</u>	<u>MCL, 700</u>	<u>98</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>Tetrachloroethene</u>	<u>MCL, 5</u>	<u>9,300</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>P-1L, P-2L, P-3F, P-3L, P-4W, P-18F, P-23K, SS-7, SUMP-1</u>
<u>Toluene</u>	<u>MCL, 1,000</u>	<u>16,000</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>1,1,1-Trichloroethane</u>	<u>MCL, 200</u>	<u>380</u>	<u>SUMP-4</u>	<u>5/2003</u>	
<u>Trichloroethene</u>	<u>MCL, 5</u>	<u>1,500</u>	<u>SUMP-4</u>	<u>5/2003</u>	<u>LM-4, P-1L, P-3F, P-3L, P-4W, P-23K, SS-7, SUMP-1</u>
<u>Trichlorofluoromethane</u>	<u>PRG, 1,300</u>	<u>140</u>	<u>P-1L</u>	<u>11/2002</u>	
<u>Vinyl chloride</u>	<u>MCL, 2</u>	<u>235</u>	<u>SUMP-4</u>	<u>5/2000</u>	<u>LM-4, P-1L, P-3F, P-3L, P-4W, SS-2, SUMP-3</u>

Notes:

From Earth Science Consultants (2000) and Herst & Associates (2001a, 2001b, 2002a, 2002b, 2002c, 2003a, 2003c, 2004a, 2004b). Values in bold type exceed the relevant standard.

* Standard for dissolved constituent provided for comparison.

** 10 micrograms per liter standard effective as of January 23, 2006

*** Also known as Prothiofos, phosphorodithioic acid, and Tokuthion. Parathion was used as a surrogate (EPA 2004a)

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EPA U.S. Environmental Protection Agency
 J Estimated
 MCL EPA maximum contaminant level (EPA 2002a)
 µg/L Micrograms per liter
 PRG EPA Region 9 preliminary remediation goals (EPA 2002b)

Table 2 - Maximum Concentrations of Constituents in Groundwater, 2004

<u>Compound of Concern</u>	<u>Relevant Standard or Criteria (µg/L)</u>	<u>Maximum Concentration Detected (µg/L)</u>	<u>Location of Maximum Concentration</u>	<u>Sampling Date</u>	<u>Other Wells above MCL or PRG</u>
Herbicides					
2,4,5-TP (Silvex)	MCL, 50	640	P-3W	2/2004	
Metals					
Antimony, total	MCL, 6*	6.0	P-18W	5/2004	
Arsenic, total	MCL, 10**	19	P-3L	2/2004	
Barium, total	MCL, 2,000	1,700	P-3W	2/2004	
Pesticides					
<u>o,o,o-</u> Triethylphosphorothioate***	PRG, 220	13	P-23K	5/2004	
Semivolatile Organic Compounds					
2,4-Dichlorophenol	PRG, 110	47	P-3W	2/2004	
Volatile Organic Compounds					
Benzene	MCL, 5	12	P-3W	2/2004	P-3F
Dichlorodifluoromethane	PRG, 390	82	P-1L	2/2004	
1,1-Dichloroethane	PRG, 800	87	P-3W	2/2004	
1,2-Dichloroethane	MCL, 5	5.8	P-23K	5/2004	
1,1-Dichloroethene	MCL, 7	9.5	P-1L	2/2004	
cis-1,2-Dichloroethene	MCL, 70	35	P-23K	5/2004	
Tetrachloroethene	MCL, 5	25	P-3F	2/2004	P-1L, P-4W, P-23K
1,1,1-Trichloroethane	MCL, 200	6.6	P-1L	2/2004	
Trichloroethene	MCL, 5	21	P-3F	2/2004	P-1L, P-4W, P-23K
Trichlorofluoromethane	PRG, 1,300	60	P-1L	2/2004	
Vinyl chloride	MCL, 2	45	P-1L	2/2004	P-3F, P-4W, SS-2

Notes:

From Herst & Associates (2004b). Values in bold type exceed the relevant standard.

* With installation of dedicated bladder pumps, only total analysis performed.

** 10 micrograms per liter standard effective as of January 23, 2006

*** Also known as Prothiofos, phosphorodithioic acid, and Tokuthion. Parathion was used as a surrogate (EPA 2004a)

EPA U.S. Environmental Protection Agency

MCL EPA maximum contaminant level (EPA 2002a)

µg/L Micrograms per liter

PRG EPA Region 9 preliminary remediation goals (EPA 2002b)

Some groundwater contamination has migrated off of the BFI property, although contaminated groundwater generally is confined to the facility. Wells on the south and southeast edge of the property (P-14, P-15, and P-18) have had recent detections of contaminants at concentrations that exceed MCL or PRG. In addition to on-site

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monitoring wells, BFI collects groundwater samples from domestic wells off the property. The well identified as WCON (a former domestic well) did have contamination in the past but has had no organic detections for 10 years (Herst [2004a](#)). The well identified as WKIN (another domestic well) has had two detections of common lab contaminants but, otherwise, no organic detections for 10 years (Herst [2004a](#)). Moreover, well clusters and seeps WKIN, WCON, WCOY, P-10, P-11, P-12, P-13, P-14, P-16, P-21, P-22, P-24, SS-3, SS-2, SS-8, and SS-12 did not have detectable concentrations of VOCs, SVOCs, pesticides, or herbicides in 2004 (Herst [2004a](#)). Although this ring of wells and seeps does not completely enclose the facility, these findings suggest that contaminated groundwater does not extend far off of the property.

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Surface and Subsurface Soil

Surface soil at the BFI facility is not likely to be contaminated. Surface soil samples were collected in 1987 during closure, and Table 3 shows the maximum concentrations of **the most significant** constituents found in those samples. None exceeded EPA Region PRGs for residential or industrial soil. In addition, during closure, waste management areas were covered with caps and vegetation, covering most of the contaminated surface soil to a depth of 3.5 feet (ESC 1995). Moreover, during closure, contaminated soil was removed from several SWMUs, including the wastewater pond, and areas were backfilled with clean soil (ESC 1995).

Subsurface soil may continue to be contaminated at the facility. Although contaminated soil was removed from several SWMUs, including the wastewater pond, and areas were backfilled with clean soil, some waste was left in place when some of the units were closed (ESC 1995). Given the closure procedures used at the facility, waste and contaminated soil likely remains at depths greater than 2 feet.

Table 3 – Maximum Concentrations of Constituents in Surface Soil, 1987

Constituent	Concentration (mg/kg)	Sample	EPA Region 9 Residential PRG (mg/kg)	EPA Region 9 Industrial PRG (mg/kg)
Barium	2.9	AC-9	5,400	67,000
Benzyl butyl phthalate	1	AC-4	12,000	100,000
Bromodichloromethane	0.067	AC-8	0.82	1.8
Cadmium	0.009	AC-7	37	450
Chlorobenzene	0.023	AC-8	150	530
Chloroform	0.075	AC-8	3.6	12
1,2-Dichloroethane	0.11	AC-6	0.28	0.6
bis(2-Ethylhexyl)phthalate	4.2	AC-6	35	120
Lead	0.008	AC-5	400	750
Methylene chloride	0.045	AC-9	9.1	21
Tetrachloroethene	0.027	AC-5	1.5	3.4
Trichloroethene	0.035	AC-4	0.053	0.11

Notes:

From Earth Science Consultants, Inc. (1992)
EPA U.S. Environmental Protection Agency
mg/kg Milligrams per kilogram
PRG EPA Region 9 preliminary remediation goals (EPA 2002b)

Surface Water

Surface water on site and off site is routinely monitored by the facility. Although some of the sample points are often dry (see Table 5), the facility regularly monitors seven surface water locations: S-1, S-2, S-3, S-5, S-6, S-7, and SCOY (ESC 1992; Herst 2004a) (see Figure 2). The facility conducts routine quarterly monitoring for VOCs, cyanide, selected metals, organochlorine pesticides, chlorinated herbicides, and dioxin/furan compounds. Recently, the facility proposed changing the sampling frequency to semi-annual (Herst 2004a). The facility also monitors surface runoff as a condition of its National Pollutant Discharge Elimination System permit at outfalls 001 (S-1) and 002 (S-2) (Herst 2004a).

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Surface water near the site contains elevated concentrations of VOCs and metals. Table 4 shows the maximum concentrations of the most significant hazardous constituents in surface water at the facility since 2000, including all detections that exceed EPA action levels, MCLs, or Region 9 PRGs. Since 2000, six compounds have been detected at concentrations that exceeded their EPA action levels, MCLs, or PRGs: arsenic (26 µg/L); cadmium (7.3 µg/L); chromium (120 µg/L); lead (60 µg/L); Lindane (0.36 µg/L); and PCE (12 µg/L). Table 5 shows all detections of the six compounds exceeding MCL – arsenic, cadmium, chromium, lead, Lindane, and PCE – since 2000. As shown in Table 5, metals only exceeded MCL after the facility stopped filtering samples and stopped reporting dissolved and total metals separately. As a result, concentrations of metals that exceed MCL likely are due to suspended sediment rather than contamination in surface water. Lindane was only detected in surface water in the first two quarters of 2002. The only dissolved compound that exceeds MCL consistently is PCE, in sampling location S-2 and S-7.

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Table 4 - Maximum Concentrations of Constituents in Surface Water, 2000 to 2004

<u>Compound of Concern</u>	<u>Relevant Standard or Criteria (µg/L)</u>	<u>Maximum Concentration Detected (µg/L)</u>	<u>Location of Maximum Concentration</u>	<u>Sampling Date</u>	<u>Other Locations above Standard</u>
<u>Arsenic, dissolved</u>	<u>MCL, 10*</u>	<u>2.09</u>	<u>S-5</u>	<u>8/2001</u>	
<u>Arsenic, total</u>	<u>MCL, 10</u>	<u>26</u>	<u>S-6</u>	<u>5/2004</u>	
<u>Beryllium, total</u>	<u>MCL, 4</u>	<u>3.9</u>	<u>S-6</u>	<u>2/2001</u>	
<u>Cadmium, total</u>	<u>MCL, 5</u>	<u>7.3</u>	<u>S-6</u>	<u>5/2004</u>	<u>S-3</u>
<u>Chromium, total</u>	<u>MCL, 100</u>	<u>120</u>	<u>S-6</u>	<u>5/2004</u>	
<u>2,4-D</u>	<u>MCL, 70</u>	<u>1.1</u>	<u>S-3</u>	<u>5/2000</u>	
<u>Demeton</u>	<u>PRG, 1.5</u>	<u>0.15</u>	<u>S-7</u>	<u>5/2004</u>	
<u>1,1-Dichloroethane</u>	<u>PRG, 800</u>	<u>14</u>	<u>S-2</u>	<u>2/2003</u>	
<u>cis-1,2-Dichloroethene</u>	<u>MCL, 70</u>	<u>15</u>	<u>S-2</u>	<u>2/2004</u>	
<u>Diethyl phthalate</u>	<u>PRG, 29,000</u>	<u>33 J</u>	<u>S-7</u>	<u>2/2003</u>	
<u>Endosulfan</u>	<u>PRG, 220</u>	<u>0.1</u>	<u>S-7</u>	<u>2/2002</u>	
<u>Lead, dissolved</u>	<u>Action Level, 15</u>	<u>3.17</u>	<u>S-3</u>	<u>2/2001</u>	
<u>Lead, total</u>	<u>Action Level, 15</u>	<u>60</u>	<u>S-6</u>	<u>5/2004</u>	<u>S-1, S-3, SCOY</u>
<u>Lindane (gamma-BHC)</u>	<u>MCL, 0.2</u>	<u>0.36</u>	<u>S-2</u>	<u>2/2002</u>	
<u>Naled</u>	<u>PRG, 73</u>	<u>0.9</u>	<u>S-7</u>	<u>5/2004</u>	
<u>Phorate</u>	<u>PRG, 7.3</u>	<u>1.7</u>	<u>S-7</u>	<u>5/2002</u>	
<u>Tetrachloroethene</u>	<u>MCL, 5</u>	<u>20</u>	<u>S-2</u>	<u>2/2002</u>	<u>S-7</u>
<u>Toluene</u>	<u>MCL, 1,000</u>	<u>6.3</u>	<u>S-2</u>	<u>5/2004</u>	
<u>2,4,5-Trichlorophenol</u>	<u>PRG, 3,600</u>	<u>10</u>	<u>S-7</u>	<u>2/2003</u>	
<u>o,o,o-Triethylphosphorothioate**</u>	<u>PRG, 220</u>	<u>110</u>	<u>S-7</u>	<u>2/2003</u>	

Notes:

From Herst & Associates (2001a, 2002a, 2003a, 2004a, 2004b). Values in bold type exceed the relevant standard. Beginning in 2003, only total metals are reported. Prior to 2003, both dissolved and total metals are provided. For years before 2003, the dissolved metals value is used.

* 10 micrograms per liter standard effective as of January 23, 2006

** Also known as Prothiofos, phosphorodithioic acid, and Tokuthion. Parathion was used as a surrogate (EPA 2004)

EPA U.S. Environmental Protection Agency

J Estimated

MCL EPA maximum contaminant level (EPA 2002a)

µg/L Micrograms per liter

PRG EPA Region 9 preliminary remediation goals (EPA 2002b)

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Table 5 – Selected Constituents in Surface Water since 2000

Constituent	Feb. Concentrations (µg/L)	Dry Wells, Feb.	May Concentrations (µg/L)	Dry Wells, May	Aug. Concentrations (µg/L)	Dry Wells, Aug.	Nov. Concentrations (µg/L)	Dry Wells, Nov.
2000								
Arsenic	2.41 (S-6)	SCOY, S-2, S-7	ND	S-2, S-5, S-7	2.09 (S-6)	SCOY, S-1, S- 2, S-3, S-7	ND	S-2, S-7
Cadmium	ND		ND		ND		ND	
Chromium	ND		ND		ND		ND	
Lead	ND		ND		5.78 (S-6)		ND	
Lindane	ND		ND		ND		ND	
PCE	ND		ND		ND		ND	
2001								
Arsenic	ND	None	ND	None	2.01 (S-3), 2.09 (S-5)	None	ND	None
Cadmium	ND		ND		ND		ND	
Chromium	ND		ND		ND		ND	
Lead	3.17 (S-3)		ND		2.91 (S-2)		ND	
Lindane	ND		ND		ND		ND	
PCE	12.6 (S-7)		ND		ND		ND	
2002								
Arsenic	ND	None	ND	None	ND	SCOY, S-1, S- 2, S-3, S-5, S-7	ND	SCOY, S-1, S-2, S-3, S-5, S-7
Cadmium	ND		ND		ND		ND	
Chromium	ND		ND		ND		ND	
Lead	ND		ND		ND		ND	
Lindane	0.36 (S-2), 0.2 S-7		0.2 (S-2)		ND		ND	
PCE	20 (S-2), 7.8 (S-7)		5.6 (S-2)		ND		ND	
2003								
Arsenic	ND	SCOY, S-1	ND	SCOY	ND	SCOY, S-1, S- 2, S-3, S-5, S- 6, S-7	ND	SCOY, S-2, S-3, S-7
Cadmium	ND		ND		ND		ND	
Chromium	ND		ND		ND		ND	
Lead	6.3 (S-6)		6.4 (S-6)		ND		16 (S-1)	
Lindane	ND		ND		ND		ND	
PCE	6.0 (S-7)		ND		ND		ND	
2004								
Arsenic	ND	S-1, S-3, S-6	26 (S-6)	None				
Cadmium	ND		7.3 (S-6)					
Chromium	ND		16 (S-1), 120 (S-6)					
Lead	ND		9.1 (S-1), 60 (S-6)					
Lindane	ND		ND					
PCE	ND		ND					

Notes:

From Herst & Associates (2001a, 2002a, 2003a, 2004a, 2004b). Values in bold type exceed the relevant standard.
Beginning in 2003, only total metals are reported. Prior to 2003, both dissolved and total metals are provided. For years before 2003, the dissolved metals value is used.
µg/L _____ Micrograms per liter
ND _____ Not detected

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Sediment

Surface water drainages at the facility have very little sediment, and that sediment is unlikely to be contaminated. Presence of sediment in drainages is highly dependent on heavy precipitation events that have resulted in soil erosion from upslope areas and subsequent deposition downslope (ESC 1992). During the RFI, most drainages inspected during field reconnaissances had minimal sediment cover (ESC 1992). Installation of the multicomponent cap during closure should prevent contaminated soil from eroding into drainages at the facility.

Indoor Air

Because no regularly occupied structures are at the facility, indoor air should not be considered contaminated (EPA 2002c).

Outdoor Air

Because of the depth to groundwater, the absence of confining features, and the facility's subsurface gas collection system, concentrations of organic vapors in outdoor air are probably not significant (ESC 1992). Because any areas of contaminated soil are covered by the multicomponent cap and by vegetation, contamination of indoor or outdoor air with soil particulate likely is minimal.

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3. Are there **complete pathways** between “contamination” and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table							
Potential Human Receptors (Under Current Conditions)							
“Contaminated” Media	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food ³
Groundwater	N	–	–	N	–	–	–
Air (indoors)	–	–	–	–	–	–	–
Soil (surface, e.g., <2 ft)	–	–	–	–	–	–	–
Surface Water	Y	–	–	Y	–	–	–
Sediment	–	–	–	–	–	–	–
Soil (subsurface e.g., >2 ft)	N	–	–	N	–	–	–
Air (outdoors)	–	–	–	–	–	–	–

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors’ spaces for Media which are not “contaminated”) as identified in #2 above.
2. enter “yes” or “no” for potential “completeness” under each “Contaminated” Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential “Contaminated” Media - Human Receptor combinations (Pathways) do not have check spaces (“___”). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

- _____ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter “YE” status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).
- X If yes (pathways are complete for any “Contaminated” Media - Human Receptor combination) - continue after providing supporting explanation.
- _____ If unknown (for any “Contaminated” Media - Human Receptor combination) - skip to #6 and enter “IN” status code

³Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

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Rationale and Reference(s)

Three media – sediment, indoor air, and outdoor air – can be excluded from further consideration because no evidence indicates that these media are contaminated at the BFI facility. Five types of receptors – workers, day care, trespassers, recreational, and food – can also be excluded. Because the landfill is closed, there are no regularly scheduled facility workers. The nearest school or church is about 0.65 mile south of the facility in Missouri City (Switchboard.com 2004), and any day care students are unlikely to have access to the facility. Because of the facility's extensive security system, trespassers at the facility are unlikely. Because of the lack of recreational facilities such as parks on or within 1 mile of the facility (see Figure 1), significant recreational use is unlikely. Because no food is produced on the property and because contaminated groundwater likely does not extend far off the property, food can also be eliminated as a likely receptor.

Two classes of receptors must be evaluated for potential exposure – residents and construction workers. Although the population density is low (fewer than 50 people per square mile), the area around the BFI facility does include scattered residences (CARES 2004) (see Figure 1). No information is available about BFI's use of contract construction workers. However, contract workers likely would perform any on-site excavation, construction, or utility work, and this class of receptors must be considered.

Only contract excavation workers would be exposed to contaminated subsurface soils, but deed restrictions limit the disturbance of subsurface materials. Because of security measures, nearby residents likely do not come into contact with soils at the facility deeper than 2 feet bgs. The final remedy decision executed by EPA in 2000 calls for institutional controls to be implemented by the facility (EPA 2000). The resulting deed restriction states that BFI "is restricted in disturbance of the hazardous waste disposal unit," which includes all of the SWMUs at the facility (Herst 2002b).

No receptors likely are exposed to contaminated groundwater by ingestion. Contaminated groundwater likely does not extend far off of the BFI property. Even assuming that groundwater contamination is more extensive than initially estimated, the area around the facility is part of the Clay County Public Water Supply District (PWSD) #4, which receives its water supply from Liberty, Missouri (ESC 1992; CARES 2004). A well survey conducted in 1991 found five actively-used drinking water wells within 1 mile of the facility. Four of these wells were completed in the alluvium of the Missouri River. The fifth well was about 75 feet deep and served a nearby gas station (ESC 1992). The gas station apparently is no longer in business (Switchboard.com 2004).

Deed restrictions on the property and limited access also limit dermal exposure to contaminated groundwater. Because of the probable limited extent of contaminated groundwater and the use of water from the Clay County PWSD, nearby residents likely do not come into contact with groundwater at the facility. The deed restriction states that BFI is "prohibited from the use of and exposure to the affected groundwater," limiting the exposure of contract construction workers (Herst 2002b).

Nearby residents or contract excavation workers may be exposed to contaminated surface water. Since 2000, sample points S-2 and S-7 have had concentrations of PCE that exceed its MCL. Because these sampling points lie outside the facility property and because the facility has no system to contain contaminated surface water, nearby residents or contract workers may be exposed to contamination in surface water. Because the intermittent streams around the facility are not known to be used for industrial or domestic water supply and because their sporadic flow makes fishing unlikely, exposure is more likely to be through dermal contact or incidental ingestion rather than deliberate or regular ingestion (ESC 1992).

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4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **“significant”**⁴ (i.e., potentially “unacceptable” because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable “levels” (used to identify the “contamination”); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable “levels”) could result in greater than acceptable risks)?

 X If no (exposures can not be reasonably expected to be significant (i.e., potentially “unacceptable”) for any complete exposure pathway) - skip to #6 and enter “YE” status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to “contamination” (identified in #3) are not expected to be “significant.”

 If yes (exposures could be reasonably expected to be “significant” (i.e., potentially “unacceptable”) for any complete exposure pathway) - continue after providing a description (of each potentially “unacceptable” exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to “contamination” (identified in #3) are not expected to be “significant.”

 If unknown (for any complete pathway) - skip to #6 and enter “IN” status code

Rationale and Reference(s):

Exposures can be considered significant if the duration or intensity of exposure to contaminated materials exceeds calculated screening levels or if the level of contamination substantially exceeds screening levels. Completed exposure pathways at BFI include:

- Contract construction workers – surface water
- Residents – surface water.

While repairing or installing utilities or performing other excavation work, contract construction workers may be exposed to surface water with concentrations of PCE that exceed its MCL. However, because contract construction workers are not full-time employees on site, their exposure is limited. Because of the limited period of contact, exposure of contract construction workers to hazardous constituents in surface water likely is not significant.

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EPA prepared a risk assessment that addressed possible exposure of children in nearby residences to contaminated surface water through occasional wading in the creek (EPA 2004). The screening concentrations for PCE were 340 µg/L for non-cancer risks and 4.67 µg/L for cancer risks.

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Although concentrations of PCE have exceeded the cancer risk, the significance of the exposure is limited by the sporadic nature of detections, the geographic limit of PCE detections, and the conservative assumptions of the risk assessment. PCE has only been detected once since May 2002 and not since February 2003. Moreover, PCE has only been detected at two surface water locations – S-2 and S-7 – rather than dispersed around the entire property. Finally, the risk assessment is based on following assumptions:

- Five hours wading per visit

⁴If there is any question on whether the identified exposures are “significant” (i.e., potentially “unacceptable”) consult a human health Risk Assessment specialist with appropriate education, training and experience.

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- One visit per week, 52 weeks per year
- 10 years of wading
- Contamination above the 4.67 µg/L screening level during every visit.

| Given the intermittent nature of the streams, these assumptions likely do not hold for nearby residents. As a result, significant exposure to PCE-contaminated surface water is unlikely.

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5. Can the “significant” **exposures** (identified in #4) be shown to be within **acceptable** limits?
- _____ If yes (all “significant” exposures have been shown to be within acceptable limits) - continue and enter “YE” after summarizing and referencing documentation justifying why all “significant” exposures to “contamination” are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).
- _____ If no (there are current exposures that can be reasonably expected to be “unacceptable”)- continue and enter “NO” status code after providing a description of each potentially “unacceptable” exposure.
- _____ If unknown (for any potentially “unacceptable” exposure) - continue and enter “IN” status code

Rationale and Reference(s):

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6. Check the appropriate RCRA Info status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the Browning-Ferris Industries facility, EPA ID #MOD000624452, located at 8501 Stillhouse Rd, Liberty, Missouri, under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

NO - "Current Human Exposures" are NOT "Under Control."

IN - More information is needed to make a determination.

| Completed by _____ Date 9/30/04
(signature)
Wray Rohrman
Project Manager, RCRA Corrective Action & Permits Branch
EPA Region 7

| Supervisor _____ Date 9/30/04
(signature)
Jody Hudson,
Associate Director of RCRA
EPA Region 7

Locations where References may be found:

EPA Region 7 Headquarters
RCRA Files
901 North 5th Street
Kansas City, Kansas 66101

Contact telephone and e-mail numbers

Wray Rohrman
(913) 551-7543
rohrman.wray@epa.gov

FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.

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FIGURES

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