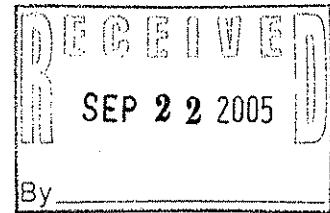


Documentation of Environmental Indicator Determination
in accordance with EPA Interim Final Guidance 2/5/99

RCRA Corrective Action
Environmental Indicator (EI) RCRA Info Code (CA750)
Migration of Contaminated Groundwater Under Control



Facility Name: Bayer CropScience
Facility Address: 8400 Hawthorne Road, Kansas City, MO
Facility EPA ID #: MOD056389828

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?

- X 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.

Bayer CropScience (Bayer) has owned and operated the agricultural chemical manufacturing facility at 8400 Hawthorne Road in Kansas City, Missouri (see Figure 1 in Appendix 1), since operations began there in 1956. The property was farmland prior to facility construction. Facility operations began under the name Chemagro. Chemagro became a wholly owned subsidiary of Bayer A.G. in 1967. In 1971, Bayer A.G. merged with Mobay Chemical Corporation, which took control of the facility. The facility name changed to Miles, Inc., in 1992, Bayer Corporation in 1995, and Bayer CropScience in 2002. These name changes were not accompanied by changes in ownership or operating responsibility (Burns & McDonnell Waste Consultants, Inc. [BMcD] 2000).

The Bayer facility covers about 216 acres, 150 of which are protected by the U.S. Army Corps of Engineers East Bottom Levee (see Figures 1 and 2 in Appendix 1). The facility is bounded by the Missouri River on the north, the Conservation Chemical Company (CCC) Superfund site on the northeast, the Blue River on the east and south, and the Kansas City Power and Light (KCPL) Hawthorn electrical generating station on the northwest. The CCC Superfund site operates a pump-and-treat remediation and containment system. A steel production facility owned by AK Steel and Compass Big Blue L.L.C. (AK Steel) is located across the Blue River to the south. The nearest residential area is about 0.5 mile southeast of the Bayer facility (Tetra Tech EM Inc. [Tetra Tech] 2003).

Since operations began in 1956, the Bayer facility has manufactured and formulated insecticides, herbicides, and fungicides—including Guithion (azinphos-methyl), disulfoton (Disyston), fenthion (Baytex), demeton (Systox), Coumaphos Metasystox, methyl phosphoro-triesters with naphthol spirits, ethyl phosphoro-triester with toluene, and tributylphosphorotrithioate (DEF) water treatment residue (BMcD 2000).

The Bayer facility is a large quantity generator of hazardous waste and a permitted hazardous waste treatment and storage facility. In 1987, Bayer received Missouri Hazardous Waste Permit Number MOD056389828 for storage and treatment of hazardous waste and for operation of a thermal oxidizer, four

thermal oxidizer storage tanks, and two container storage areas (all constructed in 1979). Bayer reapplied for the permit in 1996, and EPA approved its application in 1998. As a condition of the initial Hazardous Waste Permit, Bayer conducted a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) and a RCRA Facility Investigation (RFI). During the RFA, three solid waste management units (SWMU) and one area of concern (AOC) were identified, based on investigation results and historic land use at the Bayer facility (BMcD 2000). Following submittal of the RFI report, three additional AOCs were identified (Bayer 2000, 2001, 2002a, 2002b). These SWMUs and AOCs are depicted on Figure 2 (Appendix 1) and described as follows:

SWMUs-1, 2, 3: Areas A, B, C. From 1959 to 1973, Bayer disposed of waste in three SWMUs at the facility, referred to as Areas A, B, and C. Trenches were dug in these areas and filled with about 7,500 tons of waste. About 6,900 tons of this waste was filter aid, a diatomaceous earth paste that remains after recovery of pesticide intermediates and products. The remainder of the waste included triesters, toluene, naphthol spirits, and DEF (tribufos) treatment residue. After the waste was placed in the trenches, the areas were covered with loess (BMcD 2000).

The horizontal and vertical extent of buried waste in Areas A, B, and C has been delineated. The extent of buried waste at each area is estimated as follows:

- Area A: The extent of buried waste in this area is between 380 square yards (yd^2) and 580 yd^2 horizontally and between 12 and 13 feet deep. The total volume is between 1,520 cubic yards (yd^3) and 2,510 yd^3 .
- Area B: The extent of buried waste is between 3,900 yd^2 and 7,780 yd^2 horizontally, and between 7 and 8 feet deep. The total volume is between 9,100 yd^3 and 20,750 yd^3 .
- Area C: The extent of buried waste in this area is between 3,260 yd^2 and 8,530 yd^2 horizontally, and between 12 and 15 feet deep. The total volume is between 13,000 yd^3 and 42,650 yd^3 (BMcD 2000).

Contaminants detected in soil were similar in each area and include volatile organic compounds (VOC), semivolatile organic compounds (SVOC), and pesticides. VOCs detected included acetone, benzene, 2-butanone, chlorobenzene, chloroform, 1,2-dichloroethane, ethylbenzene, methylene chloride, 4-methyl-2-pentanone, tetrachloroethene, 1,1,1-trichloroethane, trichloroethene, toluene, and xylenes. SVOCs detected included bis(2-ethylhexyl) phthalate, dibenzofuran, diethyl phthalate, fluorene, 2-methylnaphthalene, and naphthalene. Pesticides detected included coumaphos, DEF, demeton, disulfoton, fenthion, and O,O,O-triethylphosphorothioate (O,O,O-triester). Area B typically had the highest concentrations of these compounds in surface and subsurface soil (BMcD 2000). However, a 2001 soil sample collected below the organophosphate plant—located between Areas A and B—revealed tetrachloroethene in soil at concentrations two orders of magnitude higher than in either Area A or B. Trichloroethene, toluene, and disulfoton also were detected in the boring (Missouri Department of Natural Resources [MDNR] 2001a).

The RFI report identifies Areas A, B, and C as the sources of groundwater contamination at the Bayer facility. Groundwater samples collected during the RFI revealed VOCs, SVOCs, and organophosphate pesticides as the primary constituents of concern (BMcD 2000). Groundwater samples collected during a sitewide groundwater sampling event in December 2001 detected

VOCs, SVOCs, organophosphate pesticides, and dissolved arsenic in monitoring wells in the vicinity of Areas A, B, and C (BMcD 2002).

AOC-1: Drainage Ditch. The drainage ditch trends northwest to southeast across the center of the property, just west of the administrative building. The ditch directs stormwater runoff from the Bayer facility and from the KCPL Hawthorn electrical generating station to the Blue River using a Corps of Engineers lift station. The northwest half of the ditch is grass lined and flanked by buildings and parking lots. The southeast half is lined with rip-rap boulders. The ditch receives stormwater runoff from the aboveground storage tanks, maintenance facilities, open gravel-covered areas that flank the ditch, and the open coal pile on the KCPL property to the north (BMcD 2000).

Surface soil samples were collected from the drainage ditch in 1988 and 1990, in 1997 for the RFI, and in 2000 in an investigation of stained soil in the drainage ditch. Between 1988 and 1997, soil samples were collected from 6-inch intervals between ground surface and 2 feet below ground surface (bgs). At depths between ground surface and 1 foot bgs, VOCs, SVOCs, and pesticides were detected at concentrations exceeding MDNR Cleanup Levels for Missouri (CALM) Tier 1 soil values (MDNR 2001b) and EPA Region 9 preliminary remediation goals (PRG) for residential and industrial soil (EPA 2002b). No contaminant levels exceeded regulatory criteria in soil samples collected between 1 and 2 feet bgs (BMcD 2000). As part of a culvert renovation project in 2000, stained soil was encountered 1 to 2 feet below the bottom of the drainage ditch. A grab sample of the stained soil was analyzed for VOCs, SVOCs, RCRA metals, and pesticides. Disulfoton was detected at a concentration exceeding CALM Tier 1 soil values and the EPA Region 9 PRG for residential soil. Merphos was detected at a concentration exceeding EPA Region 9 PRGs for residential and industrial soil. No oily sheen was noted on water in the ditch. Bayer removed all stained soil uncovered by the culvert renovation project and sealed the area with a clay cap. The excavated soil was disposed of in a Subtitle C landfill as nonhazardous waste. If stained soil is present outside the excavation created for the culvert renovation project, it could serve as a continuing source of contamination to groundwater. Bayer attributed the black coloration of the soil to coal fines in runoff from the KCPL coal pile to the north (Bayer 2000).

AOC-2: Partial Metal Container. The partial container was discovered during an excavation to install an underground electrical connection box at the facility entrance. No groundwater was detected in the excavation. The container was about a quarter of a metal drum filled with about a cubic foot of a white granular substance identified by Bayer's laboratory as Dyrene. Analytes detected in the granular substance included pesticides (disulfoton and merphos), VOCs (1,2-dichloroethane, benzene, and tetrachloroethene), and metals (arsenic, barium, chromium, selenium, and lead). Disulfoton and merphos were detected at concentrations above their MDNR CALM Tier 1 soil values and EPA Region 9 PRGs for residential and industrial soil. Bayer responded to the discovery of AOC-2 by excavating an area 5 feet deep and 8 feet across at the location where the container had been discovered (Bayer 2001).

AOC-3: Carbon Disulfide Wastewater Release Area. Bayer identified AOC-3 in 2002. The area is related to the historic release of small quantities of wastewater containing trace amounts of carbon disulfide. The last release of wastewater is believed to have occurred in 1999. Bayer stated that the release posed no current threat to human health or the environment. Bayer responded to the discovery of AOC-3 by investigating the historic details related to the area (Bayer 2002a).

AOC-4: Wastewater Discharge Effluent Pipe. Bayer identified a leak in the wastewater discharge effluent pipe between the U.S. Army Corps of Engineers East Bottom Levee and the Missouri and Blue rivers. The leak, which allowed release of an unknown quantity of treated effluent to the environment, was stopped upon discovery, and the pipe was repaired the following day. Bayer stated that its conservative calculations indicated no reportable quantities were exceeded, and no threat to human health or the environment existed. Bayer responded to the discovery of AOC-4 by investigating the leak (Bayer 2002d).

BACKGROUND

Definition of Environmental Indicators (for 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 EIs 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 "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "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 EIs are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated groundwater and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determination 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).

2. Is **groundwater** known or reasonably suspected to be “contaminated”¹ above appropriately protective “levels” (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

 X If yes - continue after identifying key contaminants, citing appropriate “levels,” and referencing supporting documentation.

 If no - skip to #8 and enter “YE” status code, after citing appropriate “levels,” and referencing supporting documentation to demonstrate that groundwater is not “contaminated.”

 If unknown - skip to #8 and enter “IN” status code.

Footnotes:

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 appropriate “levels” (appropriate for the protection of the groundwater resource and its beneficial uses).

Rationale and Reference(s):

Groundwater is present in the Missouri River and Blue River alluvium underlying the Bayer facility. With depth, the alluvium grades from silty clay to fine and medium sand to coarse sand and gravel. The alluvium is deposited on shale bedrock encountered between 65 and 125 feet bgs. Although groundwater is present in the underlying shale, its movement is restricted by the low conductivity of the bedrock. The water table fluctuates with river stage, precipitation, extraction, and other recharge factors. Groundwater typically flows from the Bayer facility toward the Blue River and Missouri River; however, groundwater flow direction may change during high river stages or as a result of groundwater extraction from production or other wells (see Attachment 1). Similarly, without other controls, surface water typically runs from the Bayer facility toward the Blue River and Missouri River. However, a U.S. Army Corps of Engineers East Bottom Levee separates about three-quarters of the Bayer facility from these rivers. The Blue River is about 250 feet south of the levee along the south side of the Bayer facility. The Missouri River follows the northern edge of the Bayer facility and is about 2,200 feet from the SWMUs described above. Both rivers generally flow toward the east (BMcD 2000).

Prior to the RFI, groundwater monitoring and production wells were installed and sampled at the Bayer facility in various stages. Monitoring wells MW-1, MW-2, MW-3, and MW-4 were installed in 1987 and sampled in 1988. Monitoring well MW-5 was installed in 1989. Between 1989 and 1994, three rounds of groundwater samples were collected from these five monitoring wells. In support of a remedial investigation at the CCC site east of the Levee, six monitoring wells (MW-14A, MW-14B, MW-14C, MW-17A, MW-17B, and MW-17C) were installed in the 1980s. Bayer sampled monitoring wells MW-14A and MW-17A in 1990 and all six CCC wells in 1991 and 1994. Production wells PW-1 and PW-2 were installed in 1974, and Production Well PW-3 was installed in 1992. Production well PW-2 was sampled four times between 1983 and 1994, and production well PW-3 was sampled once in 1994. Groundwater samples were analyzed for VOCs, SVOCs, or pesticides (BMcD 2000).

Many monitoring wells installed at the Bayer facility are located in clusters of shallow, intermediate, and deep wells. These well depths correspond roughly to changes in the alluvial sediment, which grades from silty clay to fine and medium sand to coarse sand and gravel with depth. Well and well cluster locations are shown in Appendix 1. A summary of the monitoring wells located at the Bayer facilities and their screened intervals is as follows:

<u>Shallow Wells</u>	<u>Intermediate Wells</u>	<u>Deep Wells</u>
• MW-1 (16-31 feet bgs)	• MW-4A (45-55 feet bgs)	• MW-6 (114-124 feet bgs)
• MW-2 (16-31 feet bgs)	• MW-8A (45-55 feet bgs)	• MW-7A (80-90 feet bgs)
• MW-3 (16-31 feet bgs)	• MW-12B (45-65 feet bgs)	• MW-10C (72.5-82.5 feet bgs)
• MW-4 (16-31 feet bgs)	• MW-13B (45-65 feet bgs)	• MW-12C (75.7-85.7 feet bgs)
• MW-5 (13-34 feet bgs)	• MW-14B (45-65 feet bgs)	• MW-14C (58-78 feet bgs)
• MW-7B (15-30 feet bgs)	• MW-16B (45.7-65.7 feet bgs)	• MW-17C (72-92 feet bgs)
• MW-8B (15-30 feet bgs)	• MW-17B (45-65 feet bgs)	• MW-18C (67.5-87.5 feet bgs)
• MW-9 (15-30 feet bgs)	• PW-1 (52-72 feet bgs)	• PW-3 (62-74 feet bgs)
• MW-10 (15-30 feet bgs)	Bedrock 133 feet bgs	Bedrock 93 feet bgs
• MW-11 (14.5-29.5 feet bgs)	• PW-2 (53-73 feet bgs)	
• MW-12 (15-30 feet bgs)	Bedrock 124 feet bgs	
• MW-13A (15-35 feet bgs)		
• MW-14A (15-35 feet bgs)		
• MW-16A (15-35 feet bgs)		
• MW-17A (15-35 feet bgs)		

As part of RFI activities conducted in 1997, groundwater samples were collected from 16 direct-push borings in Areas A, B, and C. Based on the analytical results for these groundwater samples, 10 additional groundwater monitoring wells were installed around Areas A, B, and C. Groundwater samples were collected from the new and existing wells in July and August 1997, and were analyzed for the 40 Code of Federal Regulations 264 Appendix IX constituents and organophosphate pesticides. Following this sampling event, groundwater samples were collected and analyzed primarily for VOCs, SVOCs, and demeton (BMcD 2000).

In 2000, an additional well was installed near Area A and sampled for VOCs (BMcD 2000). Bayer conducted additional groundwater sampling at the Bayer facility in 2001. Groundwater samples were analyzed for VOCs, SVOCs, organophosphate pesticides, and metals (BMcD 2002). In 2002, MDNR collected groundwater samples from three boreholes in the open field extending east from the levee to the Blue River. Borehole GW-1S was advanced to 50 feet bgs near the levee; boreholes GW-2D and GW-3D were advanced to 91 and 70 feet bgs, respectively, nearer the river. Groundwater samples were analyzed for VOCs, SVOCs, and pesticides (EPA 2003). Monitoring well groundwater samples were collected again, in 2003, in support of a Corrective Measures Study at Bayer. Groundwater samples were analyzed for VOCs, SVOCs, organophosphate pesticides, dissolved metals, and biogeochemical compounds. The biogeochemical compounds were analyzed to evaluate whether monitored natural attenuation or an in-situ reactive zone would effectively remediate the site (Terracon 2004). In 2005, groundwater samples were collected from the monitoring wells and analyzed for VOCs, O,O,O-triethylphosphorothioate, and inorganic compounds (Terracon 2005).

Table 1 summarizes the positive detections from sitewide groundwater sampling events conducted from 1997 through 2005. Detections were compared to MDNR CALM Tier 1 GTARC and/or EPA MCLs, where available (MDNR 2001b; EPA 2002a). If no MCL or GTARC value was available, the result was compared to the EPA Region 9 PRG for tap water (EPA 2002b). These values are conservative, because use of groundwater from the Bayer facility as drinking water is not anticipated (Tetra Tech 2003). Groundwater samples exceeded screening criteria for VOCs, SVOCs, pesticides, and arsenic.

TABLE 1
SOURCE AREA GROUNDWATER IMPACTS
SAMPLING EVENTS, 1997 – 2003
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Analyte	Maximum Concentration (µg/L)	Sampling Event	Location	Depth	MDNR CALM GTARC (µg/L)	EPA MCL (µg/L)	EPA PRG (µg/L)
<i>Volatile Organic Compounds</i>							
Acetone	31,000	1998	MW-10	Shallow	---	---	610
Benzene	3,800	1998	MW-10	Shallow	5	5	0.34
Carbon disulfide	110 J	2003	MW-10	Shallow	---	---	1,000
Chlorobenzene	15	2003	MW-9	Shallow	100	100	110
Chloroethane	31 J	2001	MW-8B	Shallow	---	---	4.6
Chloroform	14,000	1997	MW-10	Shallow	80	---	6.2
Chloromethane	2,900 J	2003	MW-11	Shallow	---	---	160
Cyclohexane	7.0	2003	MW-9	Shallow	---	---	10,000
1,2-Dichlorobenzene	400	1988	MW-4	Shallow	600	---	370
1,3-Dichlorobenzene	0.13 J	2003	MW-9	Shallow	1	---	180
1,4-Dichlorobenzene	0.38 J	2003	MW-9	Shallow	75	---	0.5
1,1-Dichloroethane	100 J	2001	MW-12C	Deep	---	---	810
1,2-Dichloroethane	380,000	1997	MW-10	Shallow	5	5	0.12
1,1-Dichloroethene	6.2	2003	MW-7A	Deep	7	7	340
cis-1,2-Dichloroethene	31,000	1998	MW-11	Shallow	70	70	61
trans-1,2-Dichloroethene	230	1983	MW-13A	Shallow	100	100	120
1,4-Dioxane	26,000	1997-98	MW-7A	Deep	3	---	6.1
Ethylbenzene	2,600	2003	MW-10	Shallow	700	700	2.9
Isopropylbenzene	1.9	2003	MW-9	Shallow	---	---	660
4-methyl-2-pentanone	13,000 J	2003	MW-11	Shallow	---	---	160
Methylcyclohexane	2.3	2003	MW-9	Shallow	---	---	5,200
Methylene chloride	35,000	1998	MW-11	Shallow	5	5	4.3
Tetrachloroethene	3,600	1998	MW-10	Shallow	5	5	0.66
Tetrahydrofuran	7.56	2002	GW-2D	Deep	---	---	1.6
Toluene	760,000	1998	MW-11	Shallow	150	1,000	720
1,2,4-Trichlorobenzene	0.24 J	2003	MW-9	Shallow	70	70	7.2
Trichloroethene	3,200 J	2001	MW-10	Shallow	5	5	0.028
Vinyl Chloride	16,000	1998	MW-7B	Shallow	2	2	0.02
Xylenes (total)	10,000	1998	MW-10	Shallow	320	10,000	210

TABLE 1
SOURCE AREA GROUNDWATER IMPACTS
SAMPLING EVENTS, 1997 – 2003
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Analyte	Maximum Concentration (µg/L)	Sampling Event	Location	Depth	MDNR CALM GTARC (µg/L)	EPA MCL (µg/L)	EPA PRG (µg/L)
<i>Semivolatile Organic Compounds</i>							
Aldrin	4,800	1997-98	MW-11	Shallow	0.002	---	0.004
Aniline	430	1997-98	MW-10	Shallow	---	---	12
Benzoic acid	240 J	2001	MW-10	Shallow	---	---	150,000
bis(2-Ethylhexyl)phthalate	120	2001	MW-6	Deep	6	6	4.8
Caprolactam	3,100 D	2003	MW-10	Shallow	---	---	18,000
2-Chlorophenol	17	2003	MW-11	Shallow	40	---	30
Dibenzofuran	2,400	2001	MW-10	Shallow	---	---	24
1,2-Dichlorobenzene	110	2001	MW-8B	Shallow	600	---	370
Diethyl phthalate	3,200 D	2003	MW-10	Shallow	23,000	---	29,000
2,4-Dimethylphenol	37 J	2001	MW-10	Shallow	540	---	730
1-Methylnaphthalene	27 J	2001	MW-11	Shallow	---	---	6.2
2-Methylnaphthalene	81	2003	MW-10	Shallow	---	---	6.2
2-Methylphenol	910,000	1997-98	MW-11	Shallow	---	---	1,800
4-Methylphenol	850	1997-98	MW-11	Shallow	---	---	1,800
Naphthalene	630,000	1997-98	MW-11	Shallow	100	---	6.2
Phenol	470	2001	MW-10	Shallow	4,000	---	22,000
<i>Pesticides</i>							
Azinphos-methyl	0.45 J	2001	MW-9	Shallow	---	---	1.5
Coumaphos	2.3	2002	GW-1S	Intermediate	---	---	---
Demeton (total)	6,000	2003	MW-11	Shallow	---	---	1.5
Dichlorvos	38 J	2003	MW-7B	Shallow	---	---	0.23
Disulfoton	380	2001	MW-8A	Intermediate	0.3	---	1.5
Fenthion	0.22 J	2001	MW-7B	Shallow	---	---	1.5
Merphos	160 J	2003	MW-11	Shallow	---	---	1.1
O,O,O-Triester	4,900,000	1997-98	MW-11	Shallow	---	---	1.5
<i>Dissolved Metals</i>							
Arsenic	429	2003	MW-7B	Shallow	50	50	0.045

Notes:

Bold Maximum concentration exceeds MDNR GTARC or EPA MCL, or PRG if GTARC and MCL are not available.

- | | | | |
|-------|---------------------------------------|------|---|
| --- | Not established | J | Detection is estimated at the concentration shown |
| CALM | Cleanup Levels for Missouri | MCL | Maximum contaminant level |
| D | Detection obtained using dilution | MDNR | Missouri Department of Natural Resources |
| EPA | U.S. Environmental Protection Agency | µg/L | Micrograms per liter |
| GTARC | CALM Groundwater Target Concentration | MW | Monitoring well |
| GW | Direct-push groundwater well | PRG | Preliminary remediation goal for tap water |

Sources: BMcD 2000, 2002; EPA 2002a, 2002b; MDNR 2001b; Terracon 2004a, 2004b, 2005; Tetra Tech 2005

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within “existing area of contaminated groundwater”² as defined by the monitoring locations designated at the time of this determination)?

 X If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the “existing area of groundwater contamination”²).

 If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the “existing area of groundwater contamination”²) - skip to #8 and enter “NO” status code, after providing an explanation.

 If unknown - skip to #8 and enter “IN” status code.

² “existing area of contaminated groundwater” is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of “contamination” that can and will be sampled/tested in the future to physically verify that all “contaminated” groundwater remains within this area, and that the further migration of “contaminated” groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

Rationale and Reference(s):

Under natural conditions, unconfined groundwater in the alluvial aquifer beneath the Bayer facility flows east or southeast toward the Blue and Missouri Rivers. However, three groundwater extraction wells at the Bayer facility (production wells PW-1, PW-2, and PW-3) alter this groundwater flow pattern, as do two extraction wells operated at the CCC Superfund site northeast of the Bayer facility. The Bayer production wells are screened to depths near 75 feet bgs, with bedrock 20 to 60 feet below the bottoms of the screens. Groundwater monitoring at the facility indicates that groundwater elevations in the manufacturing portion of the Bayer facility (west of the levee) have been influenced by continual pumping of the production wells, which produce a capture zone for shallow groundwater flow within the levee. Hydraulic control of groundwater at greater depths is less certain, given the limited number of deep or fully penetrating production and monitoring wells; however, groundwater modeling conducted for the neighboring CCC Superfund site indicated that a partially penetrating extraction well (total depth 82.8 feet bgs) would draw groundwater from all depths within the aquifer. Groundwater flow east of the levee is influenced by the production wells and by the Blue River and Missouri River stages. Groundwater east of the levee generally flows west toward the production wells, and flow in this direction is enhanced during high Missouri and Blue River stages. However, during very low Missouri and Blue River stages, some groundwater east of the levee may flow back toward the east (BMcD 2000). Horizontal control of groundwater flow at the Bayer facility ultimately is imposed by the hydraulic barriers of the Blue and Missouri Rivers.

These trends are evident in the historic groundwater contour maps provided in Attachment 1 (Bayer 2002b, 2002c, 2002e, 2003; BMcD 2000). All contours are drawn based on depth to groundwater measurements conducted after installation of the third production well in 1992 (BMcD 2000). Production well PW-2 was

off during the May 2002 monitoring event, and production well PW-3 was off during the February 2003 monitoring event (Bayer 2002c, 2003). All maps also include river stage measurements for the Missouri and Blue Rivers. The February 1997 groundwater contour map shows high river stages for the Missouri and Blue Rivers, respectively (BMcD 2000; Bayer 2002b). The January 1998 groundwater contour map shows low river stage for both the Missouri and Blue Rivers (BMcD 2000). The low river stage, combined with below average pumping rates for the production wells, illustrates the least amount of hydraulic capture that has occurred at the Bayer facility (BMcD 2000). A similar but less pronounced effect is apparent from the May 2002 monitoring event; however, this change appears to have resulted because production well PW-2 was temporarily out of service (Bayer 2002c).

Vertical migration of contaminated groundwater is contained by the Pleasanton Formation Shale aquitard beneath the alluvium. Estimated hydraulic conductivity of the shale aquitard is between 10^{-11} and 10^{-7} centimeters per second (Freeze and Cherry 1979). The scoured surface of the shale has been mapped using boring logs and geophysical surveys; it is encountered at depths between 65 and 120 feet bgs or elevations ranging from 571 to 663 feet above mean sea level (BMcD 2000). Retardation of vertical migration also is expected because of the vertical gradient produced by the production wells.

Hydraulic controls on groundwater flow also control migration of contamination in groundwater. The physical features that define the horizontal and vertical extent of groundwater migration—the Blue and Missouri Rivers and the Pleasanton Formation Shale aquitard—also define the existing area of groundwater contamination and prevent further migration of contamination in the horizontal and vertical downgradient directions.

Chemicals of potential concern (COPC) for the Bayer facility are identified in the facility's final human health and screening-level ecological risk assessment (Tetra Tech 2005). Historic groundwater analytical data indicate that concentrations of most COPCs within the existing area of contaminated groundwater have decreased since the 1980s, although some persist in groundwater above risk-based screening criteria.

Perimeter monitoring wells provide additional information about the COCs present near the horizontal extent of groundwater contamination. Perimeter monitoring wells MW-12B, MW-12C, MW-13A, MW-13B, MW-14A, MW-14B, MW-14C, MW-16A, MW-16C, MW-17A, MW-17B, MW-17C, MW-18C are located east of the Bayer facility, between the levee and the Blue River (see Figure 2 in Appendix 1). Of the COPCs identified in source-area groundwater samples at concentrations exceeding KDHE and EPA standards (see Table 1), 16 COPCs were identified in perimeter well groundwater samples. Table 2 shows the concentrations of COPCs detected in perimeter groundwater samples from the 1980s to 2005. During this time, all of the COPCs identified showed an overall decrease in concentration or no discernable change in perimeter well groundwater samples.

Of the COPCs identified in perimeter well groundwater samples, nine VOCs (benzene, chloroethane, 1,2-DCA, 1,2-DCE, 1,4-dioxane, methylene chloride, PCE, TCE, and vinyl chloride), a SVOC (bis[2-ethylhexyl]phthalate), a pesticide (o,o,o-triester), and a dissolved metal (arsenic) historically exceeded the MDNR GTARC or EPA MCL standard—or the EPA Region 9 PRG standard where no GTARC or MCL standard was established (see Table 2). In 2005, only the VOCs benzene and vinyl chloride exceeded their GTARC or MCL standards (Terracon 2005).

TABLE 2

PERIMETER WELL DETECTIONS
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Contaminant (µg/L)	Year	MW-12B	MW-12C	MW-13A	MW-13B	MW-13C	MW-14A	MW-14B	MW-14C	MW-16A	MW-16B	MW-17A	MW-17B	MW-17C	MW-18C
Acetone PRG = 610	1980s	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1990s	10U	10U	10U	10U	NA	1U	1U	12J	10U	10U	10U	10U	10U	10U
	2001	2.2J	10U	10U	6.8JB	NA	3.3U	10U	2J	10U	10U	10U	10U	10U	0.23U
	2003	3.9U	9.8	2.4U	2.6U	NA	2U	2U	5.4U	NA	NA	1.7U	1.6J	2U	NA
	2005	25U	25U	25U	25U	25U	25U	25U	25U	25U	25U	25U	25U	25U	25U
	1980s	54	NA	6	16	NA	NA	261	300	NA	NA	17	NA	NA	NA
Benzene GTARC/MCL = 5	1990s	10	32	1U	1U	NA	1U	52	61	1U	9	1U	1U	1U	1U
	2001	6.6J	37J	1U	4.0J	NA	1U	0.29J	0.23J	1U	2.1J	1U	1U	1U	0.41J
	2003	5.9J	40	1U	9.5	NA	1U	0.86J	0.15J	NA	NA	1U	1U	1U	NA
	2005	1.5	16	1U	2.7	1U	1U	6.5	1U	1U	1U	1U	1U	1U	1U
	1980s	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane PRG = 4.6	1990s	NA	NA	NA	NA	NA	2U	0.47J	0.65J	NA	NA	NA	NA	NA	NA
	2001	2U	8.6J	2U	2U	NA	2U	2U	2U	2U	2U	2U	2U	2U	2U
	2003	2U	1.8J	2U	2U	NA	2U	2U	2U	NA	NA	2U	2U	2U	NA
	2005	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U
Chloroform GTARC = 80	1980s	2	NA	NA	NA	NA	2	4	4	NA	2	8	2	NA	4
	1990s	1U	1U	NA	NA	NA	1U	1U	1U	NA	NA	1U	1U	1U	NA
	2001	1U	1U	1U	0.75B	NA	1U	1U	1U	1U	1U	1U	1U	1U	0.46J
	2003	1U	1U	1U	1U	NA	1U	1U	1U	NA	NA	1U	1U	1U	NA
	2005	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U	5U
1,2-Dichloroethane GTARC/MCL = 5	1980s	NA	NA	3	NA	NA	3	NA	83	4	2	NA	NA	NA	NA
	1990s	NA	NA	NA	NA	NA	1U	1U	1U	NA	NA	1U	1U	1U	NA
	2001	1U	1U	1U	9.3J	NA	1U	1.3	1U	1U	3.1J	1U	1U	1U	1U
	2003	1U	1U	1U	0.31J	NA	0.11J	0.16J	1U	NA	NA	1U	1U	1U	NA
	2005	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U	1U

Volatile Organic Compounds

TABLE 2

PERIMETER WELL DETECTIONS
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Contaminant (µg/L)	Year	MW-12B	MW-12C	MW-13A	MW-13B	MW-13C	MW-14A	MW-14B	MW-14C	MW-16A	MW-16B	MW-17A	MW-17B	MW-17C	MW-18C
O ₃ , O ₂ -Triester PRG = 1.5	1980s	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1990s	2.5J	3.0J	5.0J	5.2J	NA	5.0J	86	94	50J	2.1J	50U	50U	50U	50U
	2001	50U	2.6J	50U	3.1J	NA	50U	4.7J	13J	50U	50U	50U	50U	50U	3.8J
	2003	1.8	2	0.5U	3.2	NA	0.25J	7.7	20J	NA	NA	0.5U	0.5U	0.5U	NA
	2005	14U	14U	14U	14U	14U	14U	14U	14U	14U	14U	14U	14U	14U	14U
<i>Disolved Metals</i>															
Arsenic GTARC/MCL = 50	1980s	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	1990s	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2001	NA	4.8B	108J	8.7	NA	42.6U	NA	1.7B	138	4.9B	31.2J	56.3	6.9J	9.1J
	2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

- B** Contaminant is detected
- Shading** Concentration exceeds the MDNR GTARC or EPA MCL standard, or the EPA Region 9 PRG standard if no GTARC or MCL standard is established.
- B** Contaminant was detected in associated blank
- CALM** Cleanup levels for Missouri
- EPA** U.S. Environmental Protection Agency
- GTARC** MDNR CALM groundwater target concentration
- J** Detection is estimated at concentration shown
- MCL** EPA maximum contaminant level
- MDNR** Missouri Department of Natural Resources
- µg/L** Micrograms per liter
- MW** Monitoring well
- NA** Not available, not analyzed, or not detected
- PRG** EPA Region 9 preliminary remediation goal for tap water
- U** Contaminant is not detected at reporting limit

In 2005, benzene was detected in monitoring well MW-12C at 16 micrograms per liter ($\mu\text{g/L}$) and MW-14B at 6.5 $\mu\text{g/L}$, exceeding the MDNR GTARC and EPA MCL of 5 $\mu\text{g/L}$ (MDNR 2001b; EPA 2002a; Terracon 2005). However, the concentration of benzene in MW-12C groundwater decreased to 16 $\mu\text{g/L}$ from a concentration of 32 $\mu\text{g/L}$ in the 1990s and 40 $\mu\text{g/L}$ in 2003. Similarly, the concentration of benzene in MW-14B groundwater (6.5 $\mu\text{g/L}$) was significantly reduced from a concentration of 261 $\mu\text{g/L}$ in the 1980s (Terracon 2004a, 2005).

Also in 2005, vinyl chloride was detected in monitoring well MW-12B at 3.1 $\mu\text{g/L}$, MW-12C at 5.7 $\mu\text{g/L}$, MW-13B at 8.7 $\mu\text{g/L}$, MW-14B at 15 $\mu\text{g/L}$, and MW-16B at 4.8 $\mu\text{g/L}$ —all exceeding the MDNR GTARC and EPA MCL of 2 $\mu\text{g/L}$ (MDNR 2001b; EPA 2002a; Terracon 2005). However, concentrations of vinyl chloride in these monitoring wells decreased significantly since the 1980s, when concentrations reached 11,000 $\mu\text{g/L}$ in MW-12B, 8,000 $\mu\text{g/L}$ in MW-12C, 78 $\mu\text{g/L}$ in MW-13B, 7,380 in MW-14B, and 120 in MW-16B (Terracon 2004a, 2005).

In 2005, O,O,O- triethylphosphorothioate was not detected in any monitoring well above the reporting limit of 14 $\mu\text{g/L}$; however, it should be noted that this reporting limit is above the PRG of 1.5 $\mu\text{g/L}$ for O,O,O- triethylphosphorothioate. In 2003, O,O,O- triethylphosphorothioate was detected in monitoring well MW-12B at 1.8 $\mu\text{g/L}$, MW-12C at 2 $\mu\text{g/L}$, MW-13B at 3.2 $\mu\text{g/L}$, MW-14B at 7.7 $\mu\text{g/L}$, and MW-14C at an estimated 20 $\mu\text{g/L}$. However, concentrations of O,O,O- triethylphosphorothioate decreased significantly from the 1990s, when concentrations reached an estimated 2.5 $\mu\text{g/L}$ in MW-12B, 30 $\mu\text{g/L}$ in MW-12C, 5.2 $\mu\text{g/L}$ in MW-13B, 86 $\mu\text{g/L}$ in MW-14B, and 94 $\mu\text{g/L}$ in MW-14C (Terracon 2004a, 2005).

The CCC property is located northeast of the Bayer facility, between the levee and the Blue River. In August/September 2004, as a part of the Superfund Five-Year Review for the CCC site, EPA's contractor, Black & Veatch, collected groundwater samples from seven direct-push borings and CCC monitoring wells MW-12B and MW-12C (also used by Bayer), Bayer monitoring wells MW-13A and MW-13B, and CCC monitoring wells MW-19B, MW-19C, MW-28C, and MW-29C in 2004 (see Attachment 2). The RCRA Program elected to collect split groundwater samples which were analyzed for organopesticides that may potentially have originated from the Bayer facility. Specifically, the constituent o,o,o-triethylphosphorothioate is a chemical by-product of Bayer's processes and may be expected to be associated with the Bayer groundwater contaminant plume. O,O,O-triethylphosphorothioate was detected in groundwater samples from direct-push borings GP-1, GP-2, GP-3, and GP-4, and in monitoring wells MW-12B and MW-12C at concentrations ranging from 1.0 to 2.1 $\mu\text{g/L}$. Of these groundwater samples, GP-2 (81 feet bgs only), GP-4 (75 feet bgs only), MW-12B (65 feet bgs), and MW-12C (89 feet bgs) had concentrations exceeding the EPA Region 9 PRG of 1.5 $\mu\text{g/L}$ for O,O,O-triethylphosphorothioate. No other organopesticides were detected in groundwater (MDNR 2001b; EPA 2002a, 2002b; Black & Veatch 2005).

Two extraction wells on the neighboring CCC property and the Missouri and Blue Rivers influence groundwater flow in the vicinity of the Bayer facility. The results of the 2004 EPA groundwater sampling effort for the CCC property reveal that contaminated groundwater northeast of Bayer production well PW-3 primarily is directed to north toward the CCC extraction wells with a northeasterly influence from the Missouri River. The results of the CCC groundwater modeling are provided in Attachment 2. This study indicates that limited concentrations of COPCs in groundwater—such as the o,o,o-triethylphosphorothioate noted above—might be pulled north and northeast of the Bayer facility by the CCC extraction wells; however, these extraction wells capture the shallow and intermediate groundwater contamination and prevent further migration. Deeper groundwater contamination to a lesser degree is captured; however, the constituent o,o,o-triethylphosphorothioate was detected in the deep interval along the Blue River, but at concentrations significantly less than risk-based levels.

In summary, although COPCs have been identified in Bayer perimeter monitoring wells, available historic data indicate that these COPCs are decreasing in concentration or are at concentrations below MDNR and EPA standards. Although some fluctuations in contaminant levels have occurred, migration of contamination is controlled by the physical location of the Bayer facility and the hydraulic controls in place there and at the CCC site. The Bayer perimeter monitoring wells are located between the levee and the Blue River. The Blue and Missouri Rivers and the Pleasanton Formation Shale aquitard define the existing area of groundwater contamination and prevent further migration of contamination in the horizontal and vertical downgradient directions

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

If yes - continue after identifying potentially affected surface water bodies.

If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

Surface water in the Blue and Missouri rivers is hydraulically interconnected to groundwater in the adjacent alluvial aquifer. As shown in the groundwater contour maps and river stage information provided in Attachment 1, shallow groundwater may discharge to the Blue River during low river stage (BMcD 2000, Bayer 2002c).

Groundwater collected from perimeter monitoring wells MW-12B, MW-12C, MW-13B, MW-14B, and MW-16B was contaminated, suggesting groundwater discharging to the river is contaminated. Table 2 lists the contaminants of concern identified in groundwater samples collected from the Bayer perimeter monitoring wells located between the levee and the Blue River. Two of these contaminants—the VOCs benzene and vinyl chloride—were detected in groundwater at concentrations exceeding MDNR and EPA standards in the 2005 groundwater sampling event. Benzene was detected at concentrations up to 16 µg/L (MW-12C), above the MDNR GTARC and EPA MCL of 5 µg/L (MDNR 2001b; EPA 2002a; Terracon 2005). Vinyl chloride was detected at concentrations up to 15 µg/L (MW-14B), above the MDNR GTARC and EPA MCL of 2 µg/L (MDNR 2001b; EPA 2002a; Terracon 2005). Although O,O,O-triethylphosphorothioate was not detected in perimeter monitoring wells in 2005, the reporting limit for O,O,O-triethylphosphorothioate (14 µg/L) was above its EPA PRG of 1.5 µg/L (EPA 2002b, Terracon 2005). O,O,O-triethylphosphorothioate was detected in 2003 at concentrations up to an estimated 20 µg/L (Terracon 2004a).

In addition to sampling perimeter monitoring wells, MDNR conducted a 2002 sampling event to determine the impact of facility operations on the adjacent Blue and Missouri Rivers. Direct-push groundwater samples were collected outside the levee opposite to Area B. In groundwater samples, benzene, chloromethane, *cis*-1,2-dichloroethene, merphos oxide, and vinyl chloride exceeded KDHE GTARC and EPA MCL standards, or EPA Region 9 PRG standards where no GTARCs or MCLs were established (Tetra Tech 2005).

5. Is the **discharge** of “contaminated” groundwater into surface water likely to be “**insignificant**” (i.e., the maximum concentration³ of each contaminant discharging into surface water is less than 10 times the appropriate groundwater “level,” and there are no other conditions (e.g., the nature or number of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments or eco-systems at these concentrations)?

_____ If yes - skip to #7 (and enter “YE” status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration³ of key contaminants discharged above their groundwater “level,” the value of the appropriate “level(s),” and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgement/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments or eco-system.

X If no - (the discharge of “contaminated” groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration³ of each contaminant discharged above its groundwater “level,” the value of the appropriate “level(s),” and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations³ greater than 100 times the appropriate groundwater “levels,” the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

_____ If unknown - enter “IN” status code in #8.

³ As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

Rationale and Reference(s):

Although none of the COPCs detected in 2005 perimeter monitoring well samples were more than 10 times the appropriate MDNR or EPA groundwater standard, the 2005 sampling event was the first event in which analytical results were this low. Thus, the discharge of contaminated groundwater into surface water still is considered significant. As recently as 2003, vinyl chloride was detected in monitoring well MW-13B at a concentration of 38 µg/L, more than 10 times the MDNR GTARC and EPA MCL of 2 µg/L. Similarly, O,O,O- triethylphosphorothioate was detected in monitoring well MW-14C at a concentration of 20 µg/L, more than 10 times the EPA Region 9 PRG of 1.5 µg/L (MDNR 2001b; EPA 2002a, 2002b; Terracon 2004a) (see Table 2). Concentrations of vinyl chloride, O,O,O-triethylphosphorothioate, and all COPCs identified have stabilized or decreased from the 1980s to 2005.

6. Can the **discharge** of “contaminated” groundwater into surface water be shown to be “**currently acceptable**” (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented⁴)?

 X If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site’s surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment,⁵ appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialist(s), including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment “levels,” as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

_____ If no - (the discharge of “contaminated” groundwater cannot be shown to be “**currently acceptable**”) - skip to #8 and enter “NO” status code, after documenting the currently unacceptable impacts to the surface water body, sediments and/or eco-systems.

_____ If unknown - skip to 8 and enter “IN” status code.

⁴ Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

⁵ The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

Rationale and Reference(s):

Discharge of contaminated groundwater into the Blue River appears to be acceptable based on the decreasing COPC concentrations in monitoring wells near the Blue River, the apparent lack of contamination above levels of human health and ecological concern in surface water and sediment, the limited area of groundwater contamination, and the overall hydraulic influence exerted by Bayer’s production wells on the contaminant plume.

As recently as 2003, concentrations of vinyl chloride and O,O,O-triethylphosphorothioate have been detected in perimeter monitoring wells at concentrations more than 10 times the appropriate MDNR or

EPA groundwater standard; however, no COPCs detected in 2005 exceeded this threshold (MDNR 2001b; EPA 2002a, 2002b; Terracon 2004a, 2005). Concentrations of vinyl chloride, O,O,O-triethylphosphorothioate, and all COPCs identified have stabilized or decreased from the 1980s to 2005 (see Table 2).

In 2002, MDNR collected surface water samples from the Blue and Missouri Rivers to determine whether contamination from the Bayer facility was impacting these surface waters. Analytical results from nine Missouri and Blue River surface water samples (see Figure 3 in Appendix 1) indicate no VOC, SVOC, or pesticide compounds detected above reporting limits. Three samples also were analyzed for metals (EPA 2003). Metals, although detected, are not COPCs at the Bayer facility. No sources of metals, except for arsenic, have been linked to the Bayer facility, so risks associated with metals in surface water were not evaluated further (Tetra Tech 2005).

Analytical results from Missouri and Blue River sediment samples collected from 2002 to 2005 (see Figure 3 in Appendix 1) indicate detections of VOCs, SVOCs, and pesticides (EPA 2003, 2005a, 2005b). To determine human health impact of these detections, sediment sample results were compared to EPA PRGs for soil. No exceedances were noted (Tetra Tech 2005). To determine the ecological impact of these detections, sediment samples with contaminant concentrations two times above background were compared to risk-based sediment criteria, or Threshold Effects Levels (TEL), for protection of aquatic life (see Table 3). The TELs were developed for the COPCs identified in sediment as part of an EPA risk assessment for the site (Tetra Tech 2005). Chlordane was eliminated as a COPC because this compound was historically detected in samples from the entire length of the Blue River. At one time, a health advisory was issued for this river because of high chlordane levels. Moreover, chlordane was not produced or handled at the Bayer facility. PAHs also were eliminated because these compounds were not produced or handled at the Bayer facility. PAHs were attributed to KCPL, GST Steel, and other industrial facilities in the area (Tetra Tech 2005).

TABLE 3
SEDIMENT DETECTIONS
BLUE AND MISSOURI RIVERS
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Location	Date	Atrazine (mg/kg)	Coumpos (mg/kg)	Diazinon (mg/kg)	Disulfoton (mg/kg)	Merphos (mg/kg)	Phorate (mg/kg)	o,o,o- Triester (mg/kg)
Eco Risk TEL		0.052	0.018	0.002	0.0004	0.27	0.0005	0.27
Station 1	2005*	0.24 U	0.24 U	NA	0.06 U	0.09 U	0.045 U	0.03 U
Station 2**	2002	0.056 U	0.056 U	0.0096 J	0.013 J	0.056 U	0.056 U	0.056 U
Station 3	2002	0.051 U	0.051 U	0.051 U	0.051 U	0.027 J	0.051 U	0.051 U
Station 4	2002	0.0057 J	0.050 U	0.050 U	0.050 U	0.09 J	0.050 U	0.050 U

TABLE 3
SEDIMENT DETECTIONS
BLUE AND MISSOURI RIVERS
BAYER CROPSCIENCE FACILITY, KANSAS CITY, MO

Location	Date	Atrazine (mg/kg)	Coumpos (mg/kg)	Diazinon (mg/kg)	Disulfoton (mg/kg)	Merphos (mg/kg)	Phorate (mg/kg)	o,o,o- Triester (mg/kg)
Eco Risk TEL		0.052	0.018	0.002	0.0004	0.27	0.0005	0.27
Station 5	2002	0.045 U	0.7 J	0.01 J	0.35 J	0.3 J	0.0098 J	0.0097 J
	2004	NA	NA	0.009 U	0.029 U	0.016 J	0.028 U	0.022 U
	2005*	1.12 U	0.11 UJ	NA	1.00	3.00	0.21 U	0.14 U
		/ 0.176 U	/ 0.176 UJ	/ NA	/ 0.29	/ 0.17	/ 0.033 U	/ 0.022 U
	2005	NA	0.0097 U	0.09 U	0.029 U	0.016 J	0.028 U	0.022 U
	/ NA	/ 0.16 U	/ 0.15 U	/ 4.10 D	/ 0.51 JD	/ 0.44 U	/ 0.028 U	
Station 6	2002	0.052 U	0.052 U	0.052 U	0.0064 J	0.014 J	0.052 U	0.004 J
Station 7	2002	0.047 U	0.047 U	0.047 U	0.047 U	0.0033 J	0.047 U	0.047 U
Station 8	2002	0.0038 J	0.054 U	0.054 U	0.054 U	0.048 J	0.054 U	0.0038 J
Station 9	2002	0.047 U	0.025 J	0.047 U	0.018 J	0.0093 J	0.047 U	0.0039 J
Station 10	2005*	0.208 U	0.208 U	NA	0.052 U	0.078 U	0.039 U	0.026 U
	2005	NA	0.016 U	0.015 U	0.046 U	0.008 U	0.044 U	0.019 U
Station 11	2005	NA	0.016 U	0.015 U	0.046 U	0.008 U	0.044 U	0.019 U

Notes:

- * Split sample
- ** Background location
- Bold Contaminant is detected
- Shading Concentration is two times above background and exceeds TEL.

- D Dilution
- J Detection is estimated at concentration shown
- mg/kg Milligrams per kilogram
- TEL Threshold effects level
- U Contaminant is not detected at reporting limit shown

In 2002 and 2005, concentrations of coumpos, disulfoton, and merphos were detected at Station 5, a depositional point bar, at levels exceeding TELs for sediment and two times above background. Coumpos was detected at Station 9, diazinon was detected at Station 5, disulfoton was detected at Stations 6 and 9, and phorate was detected at Station 5 at concentrations exceeding TELs for sediment. However, these compounds were not detected at concentrations two times above background levels or, where background levels were nondetect, above the detection limit for background. Diazinon and disulfoton were detected at Station 2, the upstream or background sediment sample location (EPA 2003, 2005a, 2005b). It should be noted that detection limits were elevated in many samples due to matrix interferences.

Evaluation of the sediment samples collected from the Blue and Missouri Rivers noted one location—Station 5—where coumaphos, disulfoton, and merphos were detected above the sediment guidelines for protection of aquatic life. Remaining sediment samples were at or below sediment guidelines, indicating no potential risk to aquatic life. Significant contamination is not widespread, and potential risk to biota is limited to one location within the Blue River adjacent to the site (Tetra Tech 2005). Of the pesticides exceeding TELs for sediment and two times above background at Station 5, coumaphos and disulfoton have low potential for bioaccumulation in aquatic organisms (National Library of Medicine 2003). Merphos has a moderate to high bioaccumulation potential; however, it has a half-lives on the order of hours and days, respectively, allowing little time for bioaccumulation to occur (National Library of Medicine 2003).

The elevated COPC levels at Station 5 could be the result of one or more contaminant transport phenomena, including the discharge of contaminated groundwater to the surface water of the Blue and Missouri rivers and the accumulation of contaminants on sediment. Referencing current conditions, a screening level ecological risk assessment (SLERA) for the Bayer facility does not anticipate groundwater discharging to surface water at concentrations that could impact aquatic life in the Blue River. To evaluate the potential for site COPCs in groundwater possibly discharging to surface water, the SLERA compared estimated groundwater concentrations at the river's edge to toxicity-based screening criteria. The SLERA considered concentrations less than toxicity-based criteria for aquatic biota unlikely to represent an ecological risk (the criteria were based on values for protecting aquatic life to chronic exposure). COPC concentrations in groundwater samples collected from perimeter monitoring wells near the river's edge slightly exceed screening criteria. However, these constituents will continue to biodegrade or disperse as they migrate toward the river, thereby reducing the concentrations to values at or below the screening criteria. A SLERA screening groundwater model estimated groundwater concentrations at the river's edge under future conditions, assuming discontinued supply well operation. Model results indicated no chemicals originating in Disposal Areas A and B and Area C above the screening criteria—thus no potential for an impact on the aquatic community living in the sediments or at the sediment water interface of the Blue River (Tetra Tech 2005).

7. Will groundwater **monitoring**/measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

If no - enter "NO" status code in #8.

If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

Groundwater monitoring is ongoing at the Bayer facility. Sampling activities will follow the approved Groundwater Sampling Work Plan, dated October 26, 2001. An Interim Groundwater Monitoring Plan is under development (BMcD 2002), and long-term monitoring is expected to continue as part of any final remedy for the facility.

8. Check the appropriate RCRA Info status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the Bayer CropScience facility, EPA ID # MOD056389828, located at 8400 Hawthorne Road, Kansas City, Missouri. Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater." This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

NO - Unacceptable migration of contaminated groundwater is observed or expected.

IN - More information is needed to make a determination.

Completed by  Date 9/28/05

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Hazardous Waste Program
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Supervisor  Date 9/28/05

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