DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION
Interim Final 2/5/99
RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name:	**BASF Corporation**
Facility Address:	**Williamsburg, VA**
Facility EPA ID #:	**VAD990710642**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to the groundwater media, 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.

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 "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 EI 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 ground water 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 Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS 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.

Rationale and Reference(s):

In groundwater, the concentrations of the following constituents at the BASF facility exceed either the respective EPA Maximum Contaminant Levels for drinking water or the Virginia Alternate Concentration Limits (Risk-Based) for drinking water: Benzene (5 ug/L); 1,1 Dichloroethene (7 ug/L); cis 1,2-Dichloroethene (70 ug/L); Tetrachloroethene (5 ug/L); Trichloroethene (5 ug/L); Vinyl Chloride (2 ug/L); and Zinc (4.695 mg/L). Reference—BASF Corporation, Williamsburg Virginia, 2003 Annual Compliance Groundwater Monitoring Report (September 15, 2003).

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).

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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.

Rationale and Reference(s):

VOC Plume

VOC contaminants have been identified in the groundwater in the Office Area (3A), in the Manufacturing Area (3C-1), in the Wastewater Treatment Plant Area, and in a localized area in the Wooded Area to the north and east of the Wastewater Treatment Plant Area (1B). While the VOC concentrations in groundwater at some of the wells from these areas (e.g. BN01, BN05, MW103, MW115, has significantly declined between groundwater sampling events in 2001 and 2003, VOC concentrations over this same period have increased at other wells (e.g. MW106, MW112, MW118, TW147). Furthermore, at three monitoring wells (MW119, MW120, and MW121), installed along the James River downgradient from the contaminated groundwater zone in the Office Area, significant VOC contamination was identified in the groundwater in sampling conducted in 2002. The data from these three wells in 2002 and 2003 suggests that the VOC plume could be migrating from the groundwater offsite into the James River but is stable. However, follow-up sampling from these three wells is scheduled for September 2004 has yet to be submitted. This data would show whether the plume(s) remain stabilized in this immediate area. In the absence of new data, the conservative assumption that the levels are unchanged has been made for the groundwater-to-surface water evaluation in the EI. It is noted that the facility has implemented an in-situ groundwater remediation plan to address the VOC contamination in the groundwater in the vicinity of the three highest contamination zones of the VOC plume which are all upgradient of the MW-119, MW120 and MW121.

As indicated by the transport model results (2003) and the Groundwater Remediation Workplan (2003), the contaminant plume is approximately 1600 feet long and oriented east-west bounded by the James River on one side and MW25 on the other. The plume is 800 feet wide in the north-south orientation and, for the purposes of this EI, limited in the vertical direction by the Yorktown confining unit.

References: BASF Corporation, Williamsburg Virginia, 2003 Annual Compliance Groundwater Monitoring Report (September 15, 2003) and BASF Corporation, Williamsburg, Virginia, Groundwater Remediation Plan (September 15, 2003), December 1, 2003 Response to VDEQ Letter Dated 5, February 2003, .Development of a Groundwater Flow and Solute Transport Model (October 2003), Groundwater Results for Wells MW119, MW120, MW121 (September 2003)

Zinc Plume

High concentrations of Zinc have been identified in groundwater in areas across the facility. Significant Zinc contamination in the groundwater has been identified in the Office Area (3A), in the Manufacturing Area (3C-1), in the Utilities Area, in the Wastewater Treatment Plant Area (1B), and in the Landfill Riverfront Area (1C). The distribution in the manufacturing areas roughly mirrors that of the VOC plume described above. The most significant concentrations of Zinc in groundwater have been identified in the area of the Main Landfill (4B). Generally, Zinc concentrations in groundwater across the facility have decreased between sampling events in 2001 and 2003. The decline in Zinc is most noticeable along the boundaries of the individual areas, while some Zinc levels from interior wells have increased (e.g. at

MW70 and MW15A). Therefore, in contrast to the VOC plume, the Zinc plume(s) at the site appear to have stabilized between 2001 and 2003. Reference—BASF Corporation, Williamsburg Virginia, 2003 Annual Compliance Groundwater Monitoring Report (September 15, 2003).

A very conservative assumption can be made in the Main Landfill area that, although data indicates the zinc plume is shrinking, the lateral extent of contamination is bounded by on three sides by discharge to surface water (the James River and Woods Creek) and by decreasing concentrations on the final side. The vertical extent of the zinc contamination can be interpreted to be the top of the Yorktown. Furthermore, evidence of an upward vertical gradient has been presented that would limit the further downward migration of zinc in this area. This conservative estimate of the extent of the zinc plume is based upon reports submitted by BASF over the last 5 years and will be refined as additional information becomes available. Zinc discharges to surface water are the subject of an on-going Consent Order between the Virginia State Water Control Board and BASF.

Footnotes:

[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.

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

__X__ 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):

No surface water samples from the Tidal James River have been collected, but the VOC groundwater plume appears to impinge upon the shore of the James River (see above). In addition, discharge of zinc-contaminated groundwater to Woods Creek and the James River is not unreasonable to assume based upon concentration measured in wells closest to the water lines.

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and 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 concentration[3] 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 concentration[3] 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 concentrations[3] greater than 100 times their 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 – skip to #8 and enter "IN" status code.

Rationale and Reference(s):

The appropriate groundwater "levels" for Tetrachloroethene, Trichloroethene, and Zinc are 5, 5, and 4,695 ug/l, respectively. The most recently detected Tetrachloroethene, Trichloroethene, and Zinc concentrations (see step 4) from the monitoring wells adjacent to the James River (MW119, MW120, and MW121) were MW119--460, 91, 25,700; MW120--21, 13, <29000; and MW121—<1.0, <1.0, 20600 ug/L, respectively. Each of these detected concentrations exceed appropriate groundwater levels without the multiplication factor. With the dilution factor of 10, the measured concentrations of VOCs would exceed the appropriate groundwater levels. However, the concentrations are decreasing and will be affected by the on-going groundwater remediation activities. All discharges are expected to be acceptable with a less than 100x factor. Therefore the discharge of contaminated groundwater into the James River is potentially significant in the vicinity of MW119, MW120, and MW121.

constituent	Maximum level for 2003	Acceptable Level with 10X factor applied	Acceptable (Y/N)	Acceptable with less than 100X factor (Y/N)
Tetrachloroethene	460 (MW-119)	50	No	**Yes**
Trichloroethene	91 (MW-119)	50	No	**Yes**
Zinc	25,700 (MW-119)	46,950	**Yes**	--

Reference: BASF Corporation, Williamsburg, Virginia, Groundwater Remediation Plan (September 15, 2003). Groundwater Results for Wells MW119, MW120, and MW121 (29 September 2003)

Footnotes:

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

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 implemented[4])?

__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 ecosystems), 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 specialists, 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 into surface water is potentially significant) continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of <u>each</u> 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 concentrations[3] greater than 100 times their 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 – skip to #8 and enter "IN" status code.

Rationale and Reference(s):
The James River Estuary is listed as an Impaired Water in the Commonwealth of Virginia. Although the facility has not collected surface water data that would determine whether the groundwater discharge would be currently acceptable, the facility has implemented an interim measure (in-situ groundwater treatment) that will reduce the levels in groundwater immediately adjacent to the river. The targeted treatment area encompasses MW119.

Footnotes:

[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.

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?"

__X__ 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. 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):

BASF is required to conduct future sampling events in its ongoing Work assignments.

References: BASF Corporation, Williamsburg Virginia, 2003 Annual Compliance Groundwater Monitoring Report (September 15, 2003) and BASF Corporation, Williamsburg, Virginia, Groundwater Remediation Plan (September 15, 2003).

8. Check the appropriate RCRIS 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).

__X__ 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 **BASF Corporation** facility, **EPA ID # _VAD990710642** , located in **Williamsburg Virginia_** . 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 (original signed) Date 9/27/04
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Supervisor (original signed) Date 9/27/04
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