

**DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION**  
**Interim Final 2/5/99**  
**RCRA Corrective Action**  
**Environmental Indicator (EI) RCRIS code (CA725)**  
**Current Human Exposures Under Control**

**Facility Name:** [DuPont Spruance](#)  
**Facility Address:** [5401 Jefferson Davis Highway, Richmond, VA, 23234](#)  
**Facility EPA ID #:** [VAD00 930 5137](#)

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.  
(see "Environmental Indicator Determination Report, Current Human Exposures Under Control (CA 725)", CH2M-Hill, Aug 2001)

\_\_\_\_\_ 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 "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).

### **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).

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2. Are groundwater, soil, surface water, sediments, or air **media** known or reasonably suspected to be **“contaminated”**<sup>1</sup> above appropriately protective risk-based “levels” (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale / Key Contaminants
Groundwater	<u>X</u>	—	—	<u>HMPA, TCFM, Chloroform, Carbon Disulfide</u>
Air (indoors) <sup>2</sup>	—	<u>X</u>	—	—
Surface Soil (e.g., <2 ft)	<u>X</u>	—	—	<u>HMPA</u>
Surface Water	<u>X</u>	—	—	<u>HMPA</u>
Sediment	—	<u>X</u>	—	—
Subsurf. Soil (e.g., >2 ft)	<u>X</u>	—	—	<u>HMPA, Chloroform, Carbon Disulfide</u>
Air (outdoors)	—	<u>X</u>	—	—

— 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):

**Risk-based criteria used to evaluate site data:** Although groundwater is not used as a potable water supply onsite or downgradient of the DuPont Spruance facility, as a conservative measure, groundwater data were screened against MCLs or EPA Region III Tapwater RBCs for compounds with no MCL or SMCL. Soil data were screened against EPA Region III Industrial RBCs. Where appropriate, sediments were evaluated as soils. Best practices occupational exposure levels (e.g., DuPont acceptable exposure level [AELs], American Conference of Government Industrial Hygienist [ACGIH], or Occupational Safety and Health Administration [OSHA] permissible exposure levels [PELs]) were used to screen for volatile contaminants in air. For hexamethylphosphoramide (HMPA), which has no regulatory-derived risk criteria, best professional judgment was used to identify HMPA as a potential key contaminant in groundwater, surface water, and soil. HMPA is not considered a contaminant of air, since it is not volatile (having a vapor pressure of 0.046 mm Hg). However, an AEL (0.0005 ppm) was developed for HMPA as part of the industrial hygiene program to address potential inhalation as an aerosol when the material was used at the facility. This AEL is used as a point of reference in developing health and safety plans for excavation activities.

**Groundwater:** The previous environmental investigations at the Spruance facility have identified HMPA, trichlorofluoromethane (TCFM), and chloroform as the primary contaminants. All of these contaminants are located beneath the western half of the facility with plumes extending offsite to the south and northeast. Carbon disulfide has been detected at a small number of locations, but is not present as a widespread plume. Carbon disulfide and possibly TCFM may be present as non-aqueous phase material at the base of the shallow aquifer in a localized area of the main plant.

**Air (indoors):** Carbon disulfide is the only environmental contaminant conclusively found as non-aqueous phase in the vicinity of an occupied building with a basement. The presence is limited and localized near Teflon and Kevlar Plant 2. DuPont has had an industrial hygiene (IH) monitoring program in place that

includes personal air and area sampling in the basement and 1<sup>st</sup> and 2<sup>nd</sup> floors. With the elimination of CS<sub>2</sub> use in operations within the buildings, IH monitoring has shown no exceedences of DuPont's AEL, which is the lowest of the DuPont, ACGIH<sup>®</sup>, and OSHA occupational exposure levels from this external source. Therefore, based on empirical monitoring data, indoor air is not identified as a contaminated medium.

TCFM and chloroform plumes are present beneath portions of the main plant area and as well as offsite to the Northeast and South. In the main plant area, groundwater occurs at about 35-45 feet which makes vapor intrusion into buildings pathway unlikely. This is supported by the results of the facility's IH program that shows no evidence of exceedances of OSHA PELs or DuPont AELs. The IH program includes personal monitors as well as fixed area monitors. Offsite, groundwater concentrations are below what would be expected to cause a concern for even residential exposure using default American Society for Testing and Materials (ASTM) modeling for this pathway. Therefore, indoor air is not identified as a contaminated medium.

**Surface soil:** The previous environmental investigations at the Spruance facility have identified HMPA as the primary contaminant. The primary locations of HMPA-contaminated soils are the former Kevlar Plant 2 solvent recovery and waste storage area (SWMU-50) and the former Kevlar Market Development Facility No. 1, Loading Dock Drum Storage Area (SWMU-51). These areas are currently covered with asphalt or concrete.

**Surface Water:** The previous environmental investigations at the Spruance facility have identified HMPA as the only potential "contaminant" under the definition above, although there are no water quality criteria for this compound. Other groundwater contaminants have not been found in surface water above any water quality criteria. HMPA has been found in onsite tributaries to the James River (Grindall Creek, East Ditch, and Exxon Ditch) and offsite in the James River. HMPA has also been found in small springs or seeps along the west bank of the James River where groundwater containing HMPA is discharging to the James River.

**Sediment:** No contaminants have been detected in onsite or offsite sediments, except in the onsite polishing pond. Direct contact with sediments from the onsite polishing pond is a potential exposure pathway but only when dredged "spoils" are brought to the surface. These sediments were evaluated as soils.

**Subsurface soil:** The previous environmental investigations at the Spruance facility have identified HMPA as the primary contaminant. Other potential contaminants include TCFM, chloroform, and carbon disulfide.

**Air (outdoors):** Although outdoor air was not sampled, there is no evidence that ambient air is contaminated. Volatile organic compounds, when present, are in the subsurface at depths of approximately 20 feet or more. Further, monitoring of indoor air has not shown unacceptable air concentrations, which would lead to a reasonable conclusion that outdoor air levels would also be acceptable.

Additional supporting information and references are provided in "Environmental Indicator Determination Report, Current Human Exposures Under Control (CA 725)", CH2M-Hill, Aug 2001.

Footnotes:

<sup>1</sup>"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).

<sup>2</sup>Recent 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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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)

<b>Contaminated Media</b>	Residents	Workers	Day-Care	Construction	Trespassers	Recreation	Food <sup>3</sup>
Groundwater	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>			<u>No</u>
Air (indoors)							
Soil (surface, e.g., <2 ft)	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>Yes</u>	<u>No</u>	<u>No</u>	<u>No</u>
Surface Water	<u>Yes</u>	<u>Yes</u>			<u>No</u>	<u>Yes</u>	<u>No</u>
Sediment							
Soil (subsurface e.g., >2 ft)				<u>Yes</u>			<u>No</u>
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

Rationale and Reference(s):

**Potential human receptors** include:

1. **Resident** – since soil contamination is onsite only and groundwater is not used downgradient of Spruance, potential exposure is limited to offsite surface water;
2. **Onsite Industrial Worker** – potential exposure to groundwater (via the pump and treat system in operation), surface soil, and surface water contamination;
3. **Offsite Industrial Worker** – potential exposure is limited to surface water;
4. **Onsite Construction Worker** – potentially exposed to subsurface contamination during excavation activities, including groundwater and surface and subsurface soils;

5. **Offsite Construction Workers** – potential exposure is limited to groundwater contamination during excavation activities below the water table;
6. **Recreation Receptor** – potential exposure is limited to surface water.

**Complete Exposure Pathways by Media:**

1. **Groundwater:** Onsite industrial worker, onsite and offsite construction worker – incidental ingestion, dermal contact, and inhalation of volatile compounds. Overall potential for exposure to groundwater is low, since groundwater is not used for potable or industrial purposes onsite or downgradient of the facility. Exposure may occur during excavation activities or in relation to operation of the pump and treat system at Spruance.
2. **Surface Soil:** Onsite industrial worker and onsite construction worker – incidental ingestion, dermal contact, and inhalation of volatile compounds. Soil contamination is only present onsite, and exposure potential is low since asphalt caps covers the principal contaminated areas.
3. **Surface Water:** Resident – ingestion and dermal contact; onsite and offsite industrial worker – incidental ingestion and dermal contact; recreational user– incidental ingestion and dermal contact. Onsite surface water bodies provide potential exposure pathways for several receptors. Offsite, the James River receives contaminated groundwater discharge and provides potential exposure pathways for several receptors. The river is a potable and non-potable water supply downstream of the Spruance facility and is accessible for direct contact.
4. **Subsurface Soil:** Onsite construction worker – incidental ingestion, dermal contact, and inhalation. Subsurface soil contamination (including dredged sediments) is only found onsite and is only accessible during intrusive activities.

**Incomplete Exposure Pathways by Media:**

1. **Groundwater:** Not used as a potable or non-potable water supply onsite or downgradient of Spruance. Exposure pathways associated with day-care, recreation, and food are incomplete.
2. **Surface Soil:** Contamination limited to small areas within the facility. Therefore, all offsite receptors were eliminated. Exposure with resident, offsite industrial workers, day-care, offsite construction workers, recreation, and food are incomplete.
3. **Surface Water:** Potential exposure pathways associated with food are incomplete. Although HMPA has been detected in the James River, it does not bioaccumulate. Inhalation is not considered a significant surface water exposure route for onsite and offsite receptors because VOC concentrations in surface water have not been high enough to constitute a viable exposure route.
4. **Subsurface Soil:** Contamination is limited to small areas within the facility. Therefore, exposure pathways related to food are incomplete.

Additional supporting information and references are provided in “Environmental Indicator Determination Report, Current Human Exposures Under Control (CA 725)”, CH2M-Hill, Aug 2001.

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

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4. Can the **exposures** from any of the complete pathways identified in #3 be reasonably expected to be **“significant”**<sup>4</sup> (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):

**Groundwater Exposure Pathways:** Potential exposure for an onsite industrial worker is limited to those employed at the groundwater pump and treat system in operation at the Spruance facility. All industrial workers employed there have received special OSHA-required health and safety training and site-specific health and safety training to prevent exposures to contaminants and to protect against other health and safety hazards. In addition, all activities are required to be performed in accordance with a site-specific health and safety plan (HASP) that includes extensive procedures and mandated personal protective equipment (PPE) to prevent contaminant exposure. PPE specifications are provided for body, foot, head, eye and hand protection and respirator use based on air monitoring results. As a result of these policies and procedures, the potential for exposure of an onsite industrial worker to groundwater contamination is not significant.

Potential exposure for an onsite construction worker is not significant due to strict adherence to a rigorous system of policies and procedures employed at the Spruance facility to protect against unacceptable exposures. Since 1993, the Spruance facility has utilized a permitting process that requires Spruance Environmental Affairs’ authorization for any intrusive activities (boring, drilling, excavation, etc.) into the soils or building foundations at the facility. The purpose of the permitting process is to ensure that appropriate measures are taken for personnel protection should the intrusive activity encounter contaminated soils or groundwater. The plant’s industrial hygienist and site environmental support personnel work as a team to prepare recommendations on appropriate PPE. Depending on the location of the excavation, air monitoring is performed prior any work being performed and may continue during excavation. This enables the use of the appropriate breathing equipment. Also, workers who engage in intrusive activities in contaminated areas are required to be OSHA 1910.120 trained. It should be noted that HMPA has never been detected during excavation and groundwater work. Therefore, no breathing equipment has ever been needed due to HMPA in air.

Potential exposure for an offsite construction worker is also not significant based on a program of open communication with DuPont’s neighbors (private, corporate, public, and right-of-way users) in areas where groundwater is contaminated. The communication program includes annual sharing of new monitoring well data for wells on the subject property and as-needed construction-specific communication to assist with project management needs associated with potential human exposures and/or contaminated media disposal

requirements. DuPont has a successful history of maintaining frequent and open communication with neighboring property owners and regulatory agencies and a successful history of assistance and cooperation that has been demonstrated with neighboring property owners during construction projects. For excavation work into potentially contaminated soils or groundwater, workers are also expected to follow a site-specific health and safety plan that has been reviewed by DuPont. DuPont also performs periodic safety audits to ensure that the plans are being properly implemented.

**Surface Soil Exposure Pathways:** Virtually all of the areas at the Spruance facilities where surface soil contamination exists are covered with pavement, concrete, or an engineered asphalt cap (as is the case at the former Kevlar recovery area). It is therefore nearly impossible to be exposed to contaminated surface soils without engaging in some type of intrusive activity. As a result, the permitting process described above for intrusive activities would preclude access to contaminated soils without protective measures to prevent exposures. Due to the strict adherence to this permitting process at the Spruance facility, exposures to onsite industrial worker and onsite construction worker from surface soils are not significant.

**Surface Water Exposure Pathways:** The results of a DuPont risk evaluation of current human health and ecological risks related to HMPA in the James River indicate that exposure pathways associated with James River surface water, including resident, offsite industrial worker, offsite trespasser, and recreation exposure pathways, are not significant. Using very conservative assumptions, the results of the evaluation indicated that the estimated levels of HMPA exposure for both adults and children are at least an order of magnitude below the acceptable level. These results are indicative of a lack of significant health effects associated with the current levels of HMPA in the James River.

The remaining potentially complete exposure pathway, direct contact of onsite industrial workers with surface water, is also not significant. Although the concentrations of some onsite surface water bodies may contain concentrations of HMPA higher than in the James River, the frequency and duration of potential exposures would be extremely small in magnitude due to site access restrictions and the relative inaccessibility of surface water bodies onsite.

**Subsurface Soil Exposure Pathways:** Strict adherence to the permitting process described above for intrusive activities would preclude access to contaminated soils without protective measures to prevent exposures. As a result, exposures to onsite construction worker from contaminated surface soil are not significant.

Additional supporting information and references are provided in “Environmental Indicator Determination Report, Current Human Exposures Under Control (CA 725)”, CH2M-Hill, Aug 2001.

<sup>4</sup>If 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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6. Check the appropriate RCRIS 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 [DuPont Spruance](#) facility, EPA ID # [VAD 00 930 5137](#), located at [5401 Jefferson Davis Highway, Richmond, VA, 23234](#), 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 (signature) \_\_\_\_\_ Date 01-15-02 \_\_\_\_\_  
(print) Michael A. Jacobi  
(title) Remedial Project Manager

Supervisor (signature) \_\_\_\_\_ Date 01-15-02 \_\_\_\_\_  
(print) Robert E. Greaves  
(title) Chief, General Operations Branch  
(EPA Region or State) EPA Region 3

Locations where References may be found:

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Contact telephone and e-mail numbers

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**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**

