DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRAInfo code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: **PPG Discontinued Operations Site**
Facility Address: **PR Route 127, Guayanilla, Puerto Rico 00656**
Facility EPA ID#: **PRD000692715**

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 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 objectives 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 the RCRAInfo national database ONLY as long as they remain true (i.e., RCRAInfo status codes must be changed when the regulatory authorities become aware of contrary information).

Facility Information

The PPG Discontinued Operations Site, formerly designated as the PPG Caribe Facility, is situated on approximately 265 acres on the southwestern coast of Puerto Rico. The site is located two miles east of the town of Guayanilla, and 0.5 mile north of the town of Playa de Guayanilla. The study area for ongoing

environmental investigation covers all of the Discontinued Operations Site and areas to the south (the Betteroads Area and Playa de Guayanilla) along Guayanilla Bay.

PPG operated a chemical manufacturing facility at the site between 1971 and 1978. Facility products included chlorine, caustic soda, ethylene glycol, and vinyl chloride monomer (VCM). Manufacturing operations generated both hazardous and nonhazardous waste **streams including mercury-containing sludges, organic wastes, and chlorinated organic compounds in the heavy ends from** vinyl chloride distillation.

PPG began to close down operations at the site at the end of 1978, but PPG continued to store caustic soda on site through 1984. In 1984, PPG sold the site to Demarco Corporation for industrial metal fabrication and storage of bulk fuels and chemicals. As part of facility closure, PPG conducted extensive demolition, cleanup, and removal activities for at least 16 distinct areas at the property. Plants were decommissioned and disassembled; some plant components were cleaned; waste storage tanks were clean-closed; and hazardous waste facilities were removed, including associated sludges, concrete, synthetic-lined impoundments, wastes, and contaminated soils. Areas of known mercury contamination in soil were remediated below applicable risk-based cleanup levels for total and leachable mercury. EPA approved plans for clean closure of the various waste management units in 1984.

In 1990, PPG entered into an Administrative Order with EPA for performance of a formal RCRA Facility Investigation (RFI). Initial RFI field work, including soil and groundwater sampling, was completed between 1991 and 1994. The Draft RFI Report was issued in 1995. After reviewing the draft report, EPA required additional groundwater investigation, particularly in the Playa de Guayanilla area, and interim measures (IM) to address high concentrations of 1,2-dichloroethene and vinyl chloride in the Betteroads Area. Supplemental RFI and IM work was conducted in 1999 and 2004. These efforts included sampling of groundwater, soil, and surface water; sampling and analysis needed to support evaluation and design of potential corrective measures for groundwater contamination in the Betteroads Area; characterization of air quality; and well repair and replacement. A Draft Supplemental RFI/IM Report was issued by PPG in **December 2004 and is currently under review by EPA and the Puerto Rico Environmental Quality Board**.

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 #8 and enter "IN" (more information needed) status code.

Summary of Hazardous Waste Management Units (HWMUs) and Solid Waste Management Units (SWMUs): In its Part A Permit Application, PPG indicated that five HWMUs were in use at the facility. According to the 1990 Administrative Order (Ref. 2), further investigation and/or remediation was required for only two of these HWMUs: the Mercury Impoundment Area and the Waste Pile and Tar Pit Area. As noted in Table 1 below, post-closure groundwater monitoring has been completed for both units in accordance with the EPA-approved closure plan. Because no further action is required for the remaining HWMUs, they are not discussed further in this EI determination. In addition to the five HWMUs, a number of SWMUs were identified in the 1990 Administrative Order (Ref. 2). Two SWMUs—the API Separator and the Dichloroethane and VCM Plant—have been approved for no further action. The remaining SWMUs are listed in Table 1 below, along with their current status. It is noted that EPA has approved no further investigation or remediation of soil contamination at the PPG site (Refs. 4, 5, and 6), and has approved no further investigation or remediation at the area west of the Land Farm Area (Ref. 7).

Table 1. HWMUs and SWMUs at PPG

HWMU	Corrective Actions and Current Status
Mercury Impoundment Area (SU-110)	Area closed. Remediation began in late 1983. Impacted sludge and soil removed to target cleanup levels for total and leachable mercury. EPA accepted closure plan on September 27, 1984. Post-closure groundwater monitoring completed.
Waste Pile and Tar Pit Area	Dichloroethane and mercury reported in soil and groundwater prior to voluntary corrective measures. Source waste material and contaminated soil removed. Low residual concentrations of chlorinated volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) remain in groundwater. VOCs reported below applicable screening levels in post-remediation soil samples. EPA accepted closure plan on September 27, 1984. Post-closure groundwater monitoring completed.
SWMU	**Corrective Actions and Current Status**
Five Biological Treatment Ponds	Only operated for several months in 1978. Drained in 1979 and not subsequently used. Sludge characterized as nonhazardous. VOCs reported below applicable screening levels in soil.
Utility Pond	Sludge removed twice from pond during 1975 to 1977. Mercury reported below applicable risk-based levels in soil.

SWMU	Corrective Actions and Current Status
Salty Pond	Pond drained in early 1982. Residue and contaminated soil removed to target cleanup levels for total and leachable mercury. VOC contamination detected in groundwater. Likely source of contamination was a leak in the Salty Water Sewer System. Soils in the area of the leak were excavated to remove this potential source. Confirmatory VOC analyses in soil were not conducted nor required. Pond was backfilled in 1983.
Brine Overflow Pond	Unit dismantled in 1983. Residue and surrounding contaminated soil removed to target cleanup levels for total and leachable mercury.
Hydrogen Area	Contaminated soil and concrete removed in 1983 to target cleanup levels for total and leachable mercury.
Rubber Pit (SU 126)	Beginning in October 1982, contaminated soil was removed to target cleanup levels for total and leachable mercury.
North Concrete Pit (SU 113-A)	Unit dismantled by late 1983. Residues and surrounding contaminated soils removed to target cleanup levels for total and leachable mercury.
South Concrete Pit (SU 113-B)	Unit dismantled by late 1983. Residues and surrounding contaminated soils removed to target cleanup levels for total and leachable mercury.
Main Cells Area	From 1981 to 1984, contaminated soil and concrete **were removed to target cleanup levels for total and leachable mercury. Recent groundwater monitoring indicates that mercury is present at concentrations below applicable screening levels.**
East Mound	Actively used as a disposal site until 1978. Remedial efforts began in late 1979. Mercury and dichloroethane contamination detected in soil, along with other organic compounds. Soils were excavated, and post-remedial sampling reported VOC concentrations below applicable screening levels. Groundwater contamination detected but not yet addressed.
Land Farm Area (includes the NPDES Plow Area)	Contaminated soil above target cleanup levels for mercury and certain VOCs removed for off-site disposal in 1983. Post-remedial sampling reported VOC concentrations below applicable screening levels. Groundwater contamination detected but not yet addressed.
Salty Water Sewer System	Leaking sewer line excavated and removed, along with surrounding soil contaminated by oily wastewater. No sampling was conducted or required. Groundwater impacts identified but not specifically addressed.
Oily Sewers	No evidence of impairment of this sewer system. No remedial work was undertaken or required.

Source: References 1, 3, 5, 6, and 8.

Contamination at PPG has been adequately delineated for purposes of this EI determination. Numerous borings and over 114 monitoring wells have been advanced at the site to evaluate environmental conditions. Pre-remedial contaminants in soil included mercury and several organic contaminants, but EPA has determined that soil remediation at PPG is complete (Refs. 3, 5, and 6). Key concerns for groundwater include multiple VOC plumes spreading from the Plant Area, through the Playa de Guayanilla and Betteroads Areas, to Guayanilla Bay.

As outlined in the Draft Supplemental RFI/IM (Ref. 8), the only remaining source media at PPG is groundwater. Locally elevated VOC plume areas, particularly in shallow groundwater at the Betteroads Area and in a highly impacted column of groundwater beneath the VCM Plant Area, continue to migrate into other, less contaminated areas. Future plans for the PPG site have yet to be determined, but are likely to include implementation of an ongoing groundwater monitoring program and corrective measures for groundwater source areas (i.e., monitored natural attenuation or more active remedial efforts).

References:

1. Letter from C. Simon, U.S. EPA Region II Division of Air and Waste Management, to David C. Cannon, Jr. of PPG Industries. Dated September 27, 1984.
2. Administrative Order for PPG Industries, Inc in Guayanilla, Puerto Rico. Prepared by EPA Region II. Dated September 21, 1990.
3. RCRA Facility Investigation, Task 1: Description of Current Conditions for the PPG Discontinued Operations Site, Guayanilla, Puerto Rico. Prepared by Geraghty and Miller, Inc. Dated September 1991.
4. Letter from Philip F. Clappin, U.S. EPA Region II Hazardous Waste Compliance Branch, to Richard J. Samelson of PPG Industries. Dated October 2, 1991.
5. Letter from Philip F. Clappin, U.S. EPA Region II Hazardous Waste Compliance Branch, to Richard J. Samelson of PPG Industries. Dated January 3, 1992.
6. Draft RCRA Facility Investigation, PPG Discontinued Operations Site, Guayanilla, Puerto Rico. Prepared by Geraghty & Miller, Inc. Dated July 1995.
7. Letter from Victor Trinidad, U.S. EPA Region II Caribbean Environmental Protection Division, to Leonard Bryant of PPG Industries. Dated October 6, 1998.
8. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.

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:

SITE-SPECIFIC HYDROGEOLOGY

The PPG site is underlain by a series of alluvial and marine sedimentary hydrogeologic units that provide substantially continuous permeable zones of groundwater movement and contaminant migration in the subsurface. A general description of the hydrogeologic units identified beneath PPG and the surrounding area is presented in the paragraphs below.

The Shallow Sand unit occurs in the marine deposits and extend from the southern part of the PPG site to the shoreline beneath the Playa and the Betteroads Area. Groundwater typically occurs under unconfined conditions in the Shallow Sand unit. Beneath the Playa, the Shallow Sand is approximately 15 feet thick, consists of fine to medium grained sand with varying amounts of gravel and silt, and has a hydraulic conductivity of approximately 17 feet per day (ft/d). In the Betteroads Area, the Shallow Sand is the only widespread permeable sedimentary unit above the bedrock limestone. In this area, the Shallow Sand is generally thicker (up to 25 feet), coarser grained, and more permeable (approximately 27 ft/d) than in other study locations. The Shallow Sand is underlain by a layer of silt and clay throughout the area. Beneath the Playa and much of the Plant, the clay layer ranges in thickness from a few feet to up to 20 feet. At the Betteroads Area and beneath the southernmost portions of the Playa, the clay layer increases to as much as 70 feet thick. Measured hydraulic conductivity values for this clay layer range from 9.1×10^{-5} to 2.1×10^{-4} ft/d (Ref. 1).

The "30-Foot" Sand layer is often encountered between 30 and 40 feet below the ground surface (bgs) in the alluvial and marine deposits. This permeable layer is composed of up to 15 feet of fine to medium grained sand, with up to 40% silt and clay content in some locations. This sand occurs under the southwestern portion of the Plant site and extends through the Playa, but has not been identified in the Betteroads Area. The hydraulic conductivity of this unit has been measured at 3 ft/d. Approximately 20 feet of clay and silt separate the "30-Foot" Sand from deeper permeable zones. Analysis of lab samples

[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).

indicate that this clay layer has vertical and horizontal hydraulic conductivity values ranging from $4.5x10^{-4}$ to $2.4x10^{-2}$ ft/d.

The third permeable hydrogeologic unit at the PPG site is called the **"60-Foot" Sand** because it is usually encountered in the alluvial sediments between 60 and 70 feet bgs. This layer has the same general composition as the "30-Foot" Sand layer, but is usually thinner (i.e., less than ten feet thick), less continuous, and not as widely distributed. Beneath the Betteroads Area, this sand has been replaced by a thick sequence of clay and silt. At MW-25 the "60-Foot" Sand unit is underlain by a 60-foot thick layer of silty clay, containing approximately 25 feet of sand and rock-fragment lenses. The hydraulic conductivity values of the "60-Foot" Sand has not been determined, but is estimated to be similar to the "30-Foot" Sand based on composition and depositional environment.

The Ponce Limestone extends beneath the entire site area, unconformably underlying the sediments. An updip in the Pone Limestone has also been identified outcropping at the surface in the northern portion of the Plant site. The hydraulic conductivity of this unit has been reported at 3 ft/d.

GROUNDWATER FLOW REGIME

Groundwater flow in these hydrogeological units has been divided into five "layers" for the purposes of investigation and corrective action. Table 2 outlines the general correlations between the hydrogeologic units and the groundwater flow layers in order of increasing depth. As shown, the top three layers incorporate the sand layers, while the bottom two layers are arbitrary divisions within the Ponce Limestone. Figure 6-1 from the Supplemental RFI Draft Report (Ref. 1) presents a graphic representation of these correlations.

Table 2. Correlation Between Hydrogeologic Units and Aquifer Flow Layers

Layer	Approximate Elevation Range (ft msl)	Aquifer Zone Description
1	Land surface to -25	Identified as the water table zone in the Shallow Sand (Playa and Betteroads) and in the shallow Ponce Limestone updip under the VCM Plant.
2	-25 to -50	Identified as the "30-Foot" Sand and the corresponding updip portion of the Ponce Limestone. Includes the deeper portion of the Shallow Sand beneath Betteroads, as that unit is so much thicker in this area and no "30-Foot" Sand unit was identified.
3	-50 to -85	Identified as the "60-Foot" Sand and corresponding updip portion of the Ponce Limestone. Does not extend into the Betteroads Area.
4	-85 to -165	Identified as the portion of the Ponce Limestone immediately beneath the sedimentary deposits under the Playa and Betteroads areas, and the updip equivalent depths in the Ponce Limestone.

5	Deeper than -165	Identified as the deeper reaches of the Ponce Limestone. Only three wells have been completed in this layer (wells MW-7C, MW-11C, and MW-17C).

GROUNDWATER CONTAMINATION

Soils contaminated by historical surface spills and subsurface leaks have been removed from the facility as part of IMs under RCRA. Consequently, no continuing sources of contamination are believed to be present at the PPG site. However, all layers of groundwater at PPG and in the surrounding area to the south appear to have been impacted by site-related contamination. Figure 2-1 from the Supplemental RFI Draft Report (Ref. 1) shows the location of groundwater monitoring wells at the PPG site, in the town of Playa de Guayanilla (located immediately south of the site), and in the Betteroads Area.

During the Supplemental RFI, 19 VOCs were reported in PPG groundwater at concentrations exceeding Maximum Contaminant Levels (MCLs). Where MCLS were not available, USEPA Region 9 Preliminary Remediation Goals (PRGs) were used as the screening criteria. Contaminants of particular concern include 1,1-dichloroethene, vinyl chloride, 1,1,1-trichloroethane, trichloroethene, chloroform, benzene, and 1,2-dichloroethane. No other constituent classes (e.g., semivolatile organics, metals) were detected above applicable screening levels during the Supplemental RFI effort in 2004.

Groundwater beneath the Plant Area and the Playa reported 15 VOCs above screening levels. Table 3 lists the highest concentrations for these contaminants in the five groundwater layers. As documented in the table, the highest levels of contamination beneath the Plant and Playa were found in the deep groundwater (i.e., Layers 4 and 5) due to a downward flow gradient. The most significant groundwater contamination in this portion of the study area is located in the vicinity of well cluster MW-11.

Table 3. Plant and Playa Area Groundwater Exceedances

Contaminant	MCL* (µg/L)	Maximum Detected Concentration (µg/L) during Supplemental RFI				
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Acetone	610	NE	NE	NE	4,750	1,080
Benzene	5	27.3	7.75	22.3	9.38	16.4
Chloroethane	4.6	5.7	NE	ND	NE	9.28
Chloroform	80	NE	NE	140	12,800	86,500
Chloromethane	1.5	ND	ND	ND	NE	12.3
1,2-dichloroethane	5	8.58	6.99	29.3	1,600	166,000
1,1-dichloroethene	7	NE	305	893	2,750	3,640
cis-1,2-dichloroethene	70	NE	NE	NE	460	2,220
trans-1,2-dichloroethene	100	NE	NE	573	970	2,070
1,2-dichloropropane	5	NE	NE	NE	NE	6.27
Methylene Chloride	5	NE	NE	10.9	780	1,950
Tetrachloroethene	5	NE	6.6	72.7	90.7	261
1,1,2-trichloroethane	5	NE	10.2	13.6	158	9,680

Contaminant	MCL* (µg/L)	Maximum Detected Concentration (µg/L) during Supplemental RFI				
		Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Trichloroethene	5	NE	10.7	20.3	665	1,730
Vinyl Chloride	2	29.7	5,740	35,800	197,000	32,400

*Where MCLs were not available, Region 9 PRGs for tap water were used as the screening criteria
ND: No Detections Reported; NE: No Exceedances
Data from the Supplemental RFI Draft Report dated December 2004 (Ref. 1).
Maximum detection of each constituent is highlighted.

Groundwater beneath the Betteroads Area reported ten VOCs above applicable screening levels. Table 4 lists the highest concentrations for each of these contaminants in the two groundwater layers specific to the Betteroads Area. The three deeper layers are either not represented at Betteroads (e.g., Layer 3 consists only of clay with no aquifer present) or are more closely related to flow from the main study area. Consequently, contamination detected in Layers 4 and 5 beneath the Betteroads Area has been considered as a component of the main study area (i.e., the Plant and Playa Areas). Due to an upward groundwater flow gradient in the Betteroads Area, the highest levels of contamination were detected in shallow groundwater (i.e., Layer 1). The most significant groundwater contamination at Betteroads is located in the vicinity of well MW-40.

Table 4. Betteroads Area Groundwater Exceedances

Contaminant	MCL* (µg/L)	Maximum Detected Concentration (µg/L) during Supplemental RFI	
		Layer 1	Layer 2
Benzene	5	43.8	NE
Chloroethane	4.6	11.0	ND
1,2-dichloroethane	5	332	NE
1,1-dichloroethene	7	403	24.2
cis-1,2-dichloroethene	70	686	NE
trans-1,2-dichloroethene	100	387	NE
Tetrachloroethene	5	41.8	NE
1,1,2-trichloroethane	5	7.69	15.1
Trichloroethene	5	319	6.01
Vinyl Chloride	2	7,420	3.33

*Where MCLs were not available, Region 9 PRGs for tap water were used as the screening criteria.
ND: No Detections Reported; NE: No Exceedances
Data from the Supplemental RFI Draft Report dated December 2004 (Ref. 1).
Maximum detection of each constituent is highlighted.

Additional detail on the areal distribution of groundwater contamination is presented in the response to Question 3.

Reference:

1. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.

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:

EXTENT OF GROUNDWATER CONTAMINATION

The extent of groundwater contamination beneath the PPG site and downgradient area varies by contaminant. The following paragraphs, summarized from the Supplemental RFI and Interim Measures Draft Report (Ref. 1), present further discussion on the extent of impacts for the most pervasive groundwater contaminants associated with the PPG site.

Vinyl chloride (VC) is believed to be associated with historic spills at the VCM Plant and Betteroads, as well as accumulating daughter products from the decomposition of other chlorinated compounds in the aquifer. At the VCM Plant, VC is present in all groundwater flow layers, up to a maximum of 197,000 µg/L in Layer 4 well MW-11B. In each of the upper four layers, a second area of VC exceedances is reported beneath the Playa. These downgradient plume areas are believed to have originated at the VCM Plant and Betteroads Area, but became disconnected from the original plume area as the contaminant sources were removed. Only in Layer 4 does the disconnected VC plume area approach the Guayanilla Bay shoreline. At Betteroads, VC exceedances in Layer 1 extend from the main area of impact at well MW-40 to the shoreline at wells MW-36 and MW-37. Only isolated VC detections were reported in Layer 2 at Betteroads.

Trichloroethene (TCE) is present in all five groundwater layers beneath the VCM Plant. The highest concentration (1,730 µg/L) is reported in Layer 5 well MW-11C. TCE exceedances are also found beneath the Playa in Layers 2, 3, and 4. As with detected VC impacts, only the Layer 4 TCE impacts appear to be approaching the shoreline at present. At Betteroads, TCE exceedances are present in a

[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.

small area around Layer 1 well MW-40 and in isolated Layer 2 wells. The distribution of tetrachloroethene (PCE) is very similar to that of TCE beneath the PPG site and downgradient areas.

1,1,2-trichloroethane (TCA) is present above the PRG of 0.2 µg/L in all groundwater layers beneath the VCM Plant, with the maximum detection reported at 9,680 µg/L in Layer 5 well MW-11C. Small detached areas of TCA contamination are also present beneath the Playa in Layers 2, 3, and 4. The TCA plume in Layer 4 extends continuously from the Plant Area to Betteroads and appears to have reached the Guayanilla Bay shoreline.

Chloroform is present in all groundwater layers beneath the VCM Plant, but the most significant concentrations occur in Layers 4 and 5. Concentrations range to a maximum of 86,500 µg/L in Layer 5 well MW-11C. Disconnected chloroform plumes also appear beneath the Playa in Layers 2, 3, and 4. Lower concentrations are present in a small plume at Betteroads (up to 19.7 µg/L in Layer 2 well MW-7A), with contamination approaching the shoreline. Chloroform was manufactured at the site as an incidental byproduct of VCM and 1,2-DCA. It appears to have migrated through the shallower aquifer units, where traces of its passage have been largely erased, and is accumulating in Layer 5.

1,2-dichloroethane (1,2-DCA) is present in all groundwater layers beneath the VCM, with concentrations reaching a maximum of 166,000 µg/L in Layer 5 well MW-11C. Traces of 1,2-DCA are also present in all groundwater layers beneath the Playa. The highest concentration in this area (6.99 ug/L) occurs in Layer 2 well MW-42B. A plume of 1,2-DCA is also present in Layer 1 groundwater beneath Betteroads, between the tank that leaked and the shoreline (i.e., from well MW-40 to MW-36). A small isolated plume also exists in Layer 4 groundwater beneath the Betteroads Area and is believed to have separated from the source of contamination in the VCM Plant Area. 1,2-DCA was manufactured at the site as the principal byproduct of VCM production. As with chloroform, this constituent appears to have migrated through the shallower aquifer units, where traces of its passage have decreased, and is accumulating in Layer 5.

At the VCM Plant, **1,1-dichloroethene** (1,1-DCE) is present above applicable groundwater standards in all layers except Layer 1. The maximum concentration of 3,640 µg/L was reported in Layer 5 well MW-11C. Disconnected plumes of contamination also exist beneath the Playa, but only in Layers 2, 3, and 4. The 1,1-DCE plume in Layer 4 extends continuously from the Plant Area to Betteroads and appears to have reached the Guayanilla Bay shoreline. The plume of 1,1-DCE in Layer 1 groundwater beneath Betteroads is also approaching the shoreline.

1,2-dichloroethene (1,2-DCE) is present beneath the VCM Plant in Layers 3, 4, and 5. Maximum concentrations are reported at 2,220 µg/L for the cis- isomer and 2,070 µg/L for the trans- isomer. Only traces of 1,2-DCE are present in groundwater beneath the Playa. A very small area of 1,2-DCE contamination is also present in the Betteroads Area, centered around Layer 1 well MW-40.

Benzene is present in small, isolated pockets through all groundwater layers beneath the VCM Plant and the Playa. A small area of benzene contamination is also present in Layer 1 groundwater beneath the Betteroads Area, but this contamination has not yet reached the Bay.

Other contaminants noted in the response to Question 2 are more sparsely distributed, located within the contaminant footprints discussed above, and do not warrant specific discussion in this response.

Despite fluctuating contaminant concentrations in the central portions of the plume areas, PPG documents that overall groundwater impact areas are decreasing in size due to the actions of natural dispersion and attenuation (Ref. 1).

EXTENT OF GROUNDWATER FLOW

Groundwater beneath the PPG site and in the surrounding area generally flows from north to south, with all layers ultimately discharging into Guayanilla Bay in the vicinity of the site. Groundwater in Layer 1 also discharges into Macana River and drainage ditches (formerly referenced as canals) in the eastern and central portions of the Playa. Each of these surface water features also drains to Guayanilla Bay. Given this hydrogeological regime, Guayanilla Bay is expected to receive the majority of groundwater flow from the PPG site and surrounding area. Surface water thereby serves to limit migration of contaminated groundwater beyond the existing area of contamination across most of the study area.

A southwestward component of groundwater flow has also been observed in groundwater Layers 3 and 4. The most downgradient wells in this direction include Layer 3 wells MW-25B, MW-41C, and MW-43C and Layer 4 wells MW-25C and MW-27C. No MCL exceedances were reported in well MW-43C. Although exceedances are still reported in the other wells, site-related VOC contamination generally appears to have stabilized over time (i.e., between investigations in the mid- to late-1990s and the recent Supplemental RFI effort). In some cases, contaminant concentrations are declining. For example, the concentration of VC in well MW-25B decreased from a high of 430 μg/L in December 1994 to 138 μg/L in June 2004. VC concentrations in well MW-41C decreased from 1,000 to 371 μg/L between November 1999 and June 2004.

The only exception to these stabilizing concentrations were reported in Layer 4 well MW-25C. In this well, concentrations of 1,1-DCE and chloroform have roughly doubled since 1997. Concentrations of 1,1-DCE in well MW-25C were reported at 18 μg/L in May 1997 and 46 μg/L in June 2004 (consistently above the MCL of 7 μg/L). Concentrations of chloroform in well MW-25C rose from 68 μg/L in May 1997 (below the MCL of 80 μg/L) to 140 μg/L in June 2004. While additional groundwater monitoring and downgradient investigation is recommended to further evaluate these increasing concentrations, groundwater flowing to the southwest beneath the Playa also eventually discharges to Guayanilla Bay. Consequently, surface water again acts to limit migration of contaminated groundwater from the PPG site.

Reference:

1. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.

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:

As stated in the response to Question 3, groundwater beneath the PPG site and in the surrounding area ultimately discharges into Guayanilla Bay. Groundwater in Layer 1 also discharges into Macana River and drainage ditches (formerly referenced as canals) in the eastern and central portions of the Playa, before flowing to the Bay.

Table 5 lists the wells located upgradient of and closest to surface water discharge points, along with maximum contaminant concentrations observed in these wells during the Supplemental RFI effort. These data are organized by groundwater flow layer and receiving surface water body. Only constituents present above MCLs have been included in the table.

As shown in the table, Layer 1 wells adjacent to and upgradient of the Playa canals report no MCL exceedances for site-related groundwater contaminants. Thus, contaminated groundwater does not appear to be discharging into the Playa canals. However, Layer 1 wells upgradient of the Macana River report contamination above applicable MCLs. Wells immediately upgradient of Guayanilla Bay also report contaminant concentrations above MCLs in all groundwater flow layers. Consequently, groundwater discharges to Macana River and Guayanilla Bay must be considered further in this EI determination.

Table 5. Wells and Maximum Groundwater Contaminant Concentrations Adjacent to Surface Water in June 2004

Layer	Receiving Surface Water Body	Wells Immediately Adjacent and Upgradient	Constituent	MCL (µg/L)	Maximum Conc. June 2004 (µg/L)	Well Reporting Maximum
1	Central Playa Canal	MW-41A, MW-43A	No exceedances			
	Eastern Playa Canal	MW-27A, MW-42A	No exceedances			
	Macana River	MW-08A, MW-28A, MW-36, MW-39	Benzene	5	32.7	MW-39
			1,1-DCE	7	17.2	MW-36
			1,2-DCA	5	7.31	MW-36
			Vinyl Chloride	2	558	MW-36
	Guayanilla Bay	MW-27A, MW-28A, MW-34A, MW-37, MW-43A	1,1-DCE	7	13.8	MW-34A
			1,2-DCA	5	5.29	MW-34A
			Vinyl Chloride	2	1,870	MW-34A
2	Guayanilla Bay	MW-32B, MW-33B, MW-42B, MW-43B	1,1,2-TCA	5	6.62	MW-42B
			1,1-DCE	7	46.3	MW-42B
			1,2-DCA	5	6.99	MW-42B
			TCE	5	7.87	MW-42B
			Vinyl Chloride	2	3.5	MW-42B
3	Guayanilla Bay	MW-28B, MW-43C	1,1-DCE	7	7.46	MW-28B
4	Guayanilla Bay	MW-07B, MW-28C, MW-34B	1,1,2-TCA	5	19.8	MW-34B
			1,1-DCE	7	74.7	MW-28C
			Chloroform	80	100	MW-34B
			TCE	5	16.6	MW-28C
			Vinyl Chloride	2	23.2	MW-28C
5	Guayanilla Bay	MW-07C	1,1,2-TCA	5	32.1	MW-07C
			1,1-DCE	7	49	MW-07C
			Chloroform	80	86.3	MW-07C
			TCE	5	11.8	MW-07C

* Data from the Supplemental RCRA RFI Draft Report dated December 2004 (Ref. 1).
MCL = Maximum Contaminant Level

Reference:

1. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.

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 ecosystems at these concentrations)?

__X__ 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 ecosystem.

_____ 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 - enter "IN" status code in #8.

Rationale:

In determining whether groundwater to surface water discharges are significant for EI purposes, reported contaminant concentrations upgradient of potentially impacted surface water (listed in the response to Question 4) are compared to screening criteria based on established surface water standards. Comparison to groundwater standards such as the MCLs is not relevant in this instance because the receiving surface water bodies are not considered potential sources of drinking water. Instead, potential contaminant concentrations discharging to the Macana River and Guayanilla Bay are compared with the relevant Puerto Rico Water Quality Standards (PRWQS) for SC water bodies (i.e., tidally influenced salt water bodies protected for secondary indirect contact activities such as fishing and boating, aquatic life propagation and survival, and wildlife support). To account for dilution, dispersion, and other mitigating factors that have the effect of reducing contaminant concentrations at the point of discharge to surface water, the PRWQS are increased by a factor of 10 prior to comparison against field data. This comparison is presented in Table 6 below.

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

Table 6. Evaluation of Potential Discharges to Surface Water

Layer	Receiving Surface Water Body	Wells Immediately Adjacent and Upgradient	Constituent	Maximum Conc. June 2004 (µg/L)	PRWQS (µg/L)	PRWQS x 10 (µg/L)
1	Central Playa Canal	MW-41A, MW-43A	No exceedances			
	Eastern Playa Canal	MW-27A, MW-42A	No exceedances			
	Macana River	MW-08A, MW-28A, MW-36, MW-39	Benzene	32.7	710	7,100
			1,1-DCE	17.2	32	320
			1,2-DCA	7.31	990	9,900
			Vinyl Chloride	558	5,250	52,500
	Guayanilla Bay	MW-27A, MW-28A, MW-34A, MW-37, MW-43A	1,1-DCE	13.8	32	320
			1,2-DCA	5.29	990	9,900
			Vinyl Chloride	1,870	5,250	52,500
2	Guayanilla Bay	MW-32B, MW-33B, MW-42B, MW-43B	1,1,2-TCA	6.62	420	4,200
			1,1-DCE	46.3	32	320
			1,2-DCA	6.99	990	9,900
			TCE	7.87	810	8,100
			Vinyl Chloride	3.5	5,250	52,500
3	Guayanilla Bay	MW-28B, MW-43C	1,1-DCE	7.46	32	320
4	Guayanilla Bay	MW-07B, MW-28C, MW-34B	1,1,2-TCA	19.8	420	4,200
			1,1-DCE	74.7	32	320
			Chloroform	100	4,700	47,000
			TCE	16.6	810	8,100
			Vinyl Chloride	23.2	5,250	52,500
5	Guayanilla Bay	MW-07C	1,1,2-TCA	32.1	420	4,200
			1,1-DCE	49	32	320
			Chloroform	86.3	4,700	47,000
			TCE	11.8	810	8,100

* PRWQS = Puerto Rico Water Quality Standards

As shown in Table 6, no groundwater contaminants identified adjacent to surface water (i.e., as presented in the response to Question 4) exceeded the applicable PRWQS multiplied by a factor of 10. Consequently, contaminant concentrations potentially discharging from PPG groundwater to surface water can be considered insignificant for purposes of this EI determination.

Reference:

1. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.

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 ecosystems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

_____ 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 specialist, including an ecologist) adequately protective of receiving surface water, sediments, and ecosystems, 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 can not 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 ecosystem.

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

Rationale:

Not applicable. See the response to Question 5.

[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.

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

Rationale:

Although an ongoing monitoring program has yet to be formally initiated for the PPG site, such actions will be required pursuant to the existing Administrative Order from EPA (Refs. 1 and 3). Specifically, the Order requires that PPG implement monitoring and any additional work EPA deems necessary to protect human health and the environment.

In anticipation of such activity, PPG implemented substantial monitoring well upgrading and repair activity in April and June 2004 (Ref. 2). Efforts were made to improve the physical characteristics of the wells (e.g., painting, trimming weeds and brush, and similar activities), but the most important repairs were made to retain the overall integrity of the network and to recover or replace wells that had been damaged. Improvements included installing well number tags on all wells (to assist in well identification), replacing broken or rusted protective casings, reinforcing protective casings to protect from vandalism, and surveying wells that had measuring point adjustments during well repair. A total of 114 wells were in place and in operable condition across the site as of June 2004.

References:

1. Administrative Order for PPG Industries, Inc in Guayanilla, Puerto Rico. Prepared by EPA Region II. Dated September 21, 1990.
2. Supplemental RCRA Facility Investigation and Interim Measures Draft Report for the PPG Discontinued Operations Site. Prepared by Earth Tech, Inc. Dated December 15, 2004.
3. Personal Communication between Michele Benchouk, Booz Allen Hamilton, and Richard Krauser, EPA Region 2, on May 26, 2005.

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 PPG Discontinued Operations site, EPA ID #PRD000692715, located on PR Route 127 in Guayanilla, Puerto Rico. 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 if 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:_____

Michele Benchouk
Environmental Consultant
Booz Allen Hamilton

Reviewed by: _____ Date:_____

Lucas Kingston
Consultant
Booz Allen Hamilton

Also reviewed by: _____ Date:_____

Luís Negrón, Project Manager
Environmental Management Branch
Caribbean Environmental Protection Division
USEPA Region 2

_____ Date:_____

Victor Trinidad, Chief
Environmental Management Branch
Caribbean Environmental Protection Division
USEPA Region 2

Approved by: _____ Date:_____

Carl-Axel P. Soderberg, Director
Caribbean Environmental Protection Division
USEPA Region 2

Locations where references may be found:

References reviewed to prepare this EI determination are identified after each response. Reference materials are available at the USEPA Region 2, RCRA Records Center, located at 290 Broadway, 15th Floor, New York, New York.

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Attachments

The following attachments have been provided to support this EI determination.

- Attachment 1 - Summary of Media Impacts Table

Attachment 1 - Summary of Media Impacts Table
PPG Discontinued Operations Site

AEC	GW	Air (Indoors)	Surface Soil	Surface Water	Sediment	Subsurface Soil	Air (Outdoors)	Corrective Action Measure	Key Contaminants
Groundwater – Plant and Playa Areas	Yes	No	No	No	No	No	No	▸ None implemented to date	VOCs (including benzene, chloroform, 1,2,-DCA, 1,1-DCE, PCE, TCA, TCE, and VC)
Groundwater – Betteroads Area	Yes	No	No	No	No	No	No	▸ None implemented to date	VOCs (including benzene, chloroform, 1,1-DCE, TCA, and VC)