DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

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

Facility Name: **Chevron Phillips Chemical Puerto Rico Core, Inc.**
Facility Address: **Road #710 and State Route #3, Guayama, Puerto Rico 00655**
Facility EPA ID#: **PRD991291972**

Definition of Environmental Indicators (for the RCRA Corrective Action)

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

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While final remedies remain the long-term objective of the RCRA Corrective Action program, the EIs are near-term objectives, which are currently being used as program measures for the Government Performance and Results Act of 1993 (GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated groundwater and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination or for 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 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).

Facility Information

Chevron Phillips Chemical Puerto Rico Core, Inc., (CPCPRC) is a 211-acre petrochemical plant located on the southeast coast of Puerto Rico, just west of the town of Guayama and approximately one-quarter mile north of the Caribbean Sea. The CPCPRC facility was originally constructed in 1966 on land previously graded and used for sugar cane cultivation. A man-made harbor, Las Mareas Harbor, built approximately one-half mile southwest of the main operation area, is used for receiving and shipping

CPCPRC products.

The plant is located in the Coastal Lowlands physiographic province, which is approximately three miles wide and occurs along much of the southern coast of Puerto Rico. The general topography of the area is gently sloping, dipping southward from the mountains to the coast.

Several industrial facilities are located north of Highway 3, which is approximately one-half mile north of the facility. Directly west of the facility is a sugar cane field (West Cane Field) on which Advanced Energy Systems (AES) is constructing a new power station. Sugar cane fields lie to the east of the facility, while a mangrove area lies to the south of the facility. The village of Las Mareas, a small community consisting of a single row of dwellings, is located approximately 1,000 feet south of the site, on the coast of the Caribbean Sea. The Puerto Rico Aqueduct and Sewer Authority (PRASA) operates a wastewater treatment facility directly northeast of the facility. An effluent pipe runs from the PRASA facility toward the Las Mareas community southward along the eastern border of the facility.

The facility is divided into four main operational areas: (1) the process area, (2) the tank storage area, (3) the wastewater treatment area, and (4) Las Mareas Harbor. CPCPRC processes naphtha into a variety of refined hydrocarbon products including, but not limited to, benzene, toluene, xylenes, cyclohexane, liquid petroleum gas, gasoline, and diesel fuels. Approximately 21 permanent structures are located at CPCPRC, primarily in the northern portion of the site, and house the majority of the process area operational/support centers and storage. These structures range in size from a large warehouse and shop building to small structures, which contain chemicals and supplies. The facility currently has three National Pollutant Discharge Elimination System (NPDES) permitted outfalls that discharge into the effluent channel located in the southern portion of the CPCPRC facility.

The U.S. Environmental Protection Agency (EPA) issued an Administrative Consent Order (ACO) to CPCPRC in September 1989 pursuant to Section 3013 of RCRA. Upon completion of the requirements of Section 3013, EPA determined that corrective action was necessary and issued an ACO to CPCPRC pursuant to Section 3008(h) of RCRA in September 1995. The facility submitted a RCRA permit application in September 1991, but subsequently withdrew it in 1992. A draft RCRA Facility Investigation (RFI) was completed in May 1995. Ongoing investigations were reported in a 1998 Supplemental RFI and a 1999 final RFI. EPA conditionally approved the July 1999 Final RFI in September 1999. A Corrective Measures Study (CMS) Work Plan was completed in September 2000 and a subsequent Risk Characterization Report was submitted in July 2001. The facility submitted a CMS-Related Investigations Report in May 2003.

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 (SWMUs), Regulated Units (RUs), and Areas of Concern (AOCs)), 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 Operable Units (OUs): The CPCPRC facility has been the subject of ongoing investigations since 1989. The facility has been subdivided into ten operable units (OUs). These operable units include the Production Area (OU1), the Harbor Facility (Ballast Water Treatment Facility) (OU2), the Production Facility Lime Ponds and Sewers (OU3), the Southeast Lime Sludge Management Area (OU4), the Southwest Lime Sludge Management Area (OU5), the Scrap Pile Storage Area (OU6), the Land Treatment Area (OU7), Surface Impoundments (OU8), the Cooling Towers Area (OU9), and the Miscellaneous Hazardous Materials Management Area (OU10). The location of each operable unit is shown in Figure 5-1 of the July 1999 RFI Report (Ref. 1).

While groundwater contamination extends beneath many of the these operable units, groundwater contamination at the facility is comprised of several large commingled plumes originating in OU1, the Production Area. The Production Area consists of areas where hydrocarbons are produced and/or stored. The following operational equipment or areas constitute the Production Area: numerous tank storage areas, the container storage area, the sludge pit at the API separator, the API oil separator system, the storm water pond, the holding pond, the mix box, the oxidation pond (also part of OU8), the clarifier, the knockout pot, the flares, the fire fighting training area, the former underground storage tank (UST) area, the off-spec pond (also part of OU8), the truck loading area, the process (production) area, the burner cleaning waste management sites, and the land treatment unit (Ref. 1). These areas have been investigated during the RFI and subsequent investigations.

Groundwater investigations began in 1989 as part of the RFI when sampling detected the presence of petroleum hydrocarbons, existing both as light non-aqueous phase liquid (LNAPL) and dissolved phase contamination, over much of CPCPRC facility. This contamination is due largely to multiple and overlapping sources of hydrocarbons from spills, leaks, and past management practices. While releases have likely occurred at a number of points within the Production Area, large releases in several of the tank farm areas are primarily responsible for the aerially extensive groundwater contamination observed at the facility. While a number of volatile organic compounds (VOCs) and metals (chromium and lead) have been detected in excess of National Primary Drinking Water Maximum Contaminant Levels (MCLs) (Ref. 1), the primary constituents identified in the plume are benzene, toluene, ethyl benzene, and xylene (BTEX) compounds. The migration of the contaminant plume (both LNAPL and dissolved phase) is largely controlled by the presence of sand lenses in the alluvial and marine deposits on site.

These separate migration pathways combined with separated release areas have resulted in the formation of three contaminant plumes in the shallow alluvial flow system. Near the southeast perimeter of the facility, petroleum hydrocarbon has migrated from Tank Basin B through Tank Basin C toward the southeastern boundary of the facility. This plume is know as the Southeast Perimeter Plume. Petroleum hydrocarbons have also migrated south from the southern end of Tank Basin K to the southeast corner of the effluent channel. This plume is know as the Southeast Corner Plume. Starting at Tank Basin A,

petroleum hydrocarbon has migrated west-southwest toward the west cane field. This plume is know as the West Cane Field Plume. Each of these three plumes have migrated beyond the facility boundary. Depictions of these plumes can be seen in Plates D, E, and F of the Final RFI Report (Ref. 1).

Contamination has also entered the deeper alluvial flow systems. The deeper alluvial system is characterized by more extensive sands and a single, more aerially extensive plume has been observed in the deeper alluvial system. BTEX compounds have been detected in both the upper and lower alluvial units. Depictions of the plume in the deeper alluvial flow system in 1999 and 2002 can be seen in Figures 4-2 and 4-3, respectively, of the May 2003 CMS-Related Investigations Report (Ref. 2)

References:

1. Final RCRA Facility Investigation Report, Phillips Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated July 1999.

2. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.

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:

The CPCPRC facility is located in the south coast groundwater province of Puerto Rico. This province is defined by the alluvial plain aquifer that extends from Ponce (approximately 30 miles west of the facility) to Patillas (approximately 9 miles to the east of the facility). The facility is located in the area where coarser-grained fan material transition into finer grained coastal marine beach and lagoon sediments (Ref. 1).

Individual yields from wells completed in the alluvial fan sediments reportedly range from 40 to 2,000 gallons per minute, depending on the well's proximity to the coarse-grained deposits. Two water bearing units, the upper and lower alluvial units, are present beneath the facility. Regional groundwater flow in the South Coastal Plain aquifer (upper and lower alluvial units) is generally toward the south. The facility is in an area where groundwater, particularly the lower alluvial unit, occurs locally under confined conditions. Confined conditions become more prevalent in the lower alluvial unit in portions of the facility and downgradient areas closer to the Carribean Sea. In the southern portion of the facility, groundwater flow in the upper alluvial unit diverges from the general regional southward flow and separates into a southeasterly and a southwesterly flow direction. This change in groundwater flow direction is believed to be due to geologic controls at the site, the permeability contrasts, and local recharge. The groundwater flow direction of the lower alluvial unit underneath the site is generally south-southwest (Ref. 1).

Groundwater at this site has been monitored since 1989 and on a semi-annual basis since June 1998 (Refs. 1, 2). A summary of the chemicals detected in the upper and lower alluvial aquifers during semi-annual monitoring since June 1998 is presented Tables 3-1 and 3-2 of the May 2003 CMS-Related Investigations Report (Ref. 2). This summary indicates that, historically, the principal contaminants have been BTEX compounds. Of the BTEX compounds, benzene has been the predominant contaminant. Other compounds associated with petroleum products, principally naphthalene, have been detected, but at significantly lower concentrations. Tert-butyl methyl ether (MTBE) has been detected in significant concentrations. Elevated metal concentrations, primarily arsenic, lead, and total chromium, have also been detected in groundwater, but concentrations of these compounds are highly variable, localized, and are not considered to be migrating in groundwater at significant concentrations. Arsenic is not believed to be associated with facility activities.

[1] "Contamination" and "contaminated" describe 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).

Recent groundwater quality data from the December 2002 sampling round indicate the currently detected maximum concentrations for benzene, toluene, ethylbenzene, and xylenes are 342 parts per million (ppm), 24.8 ppm, 2.3 ppm, and 11.9 ppm, respectively (Appendix B of Ref. 1). The Federal Drinking Water Maximum Contaminant Limits (MCLs) for benzene, toluene, ethylbenzene, and xylenes are 0.005 ppm, 1.0 ppm, 0.7 ppm, and 10 ppm, respectively. The maximum detected values of the BTEX greatly exceed their respective MCLs. MTBE was not detected in the December 2002 sampling round. However, elevated detection limits of 700 ppb were required due to the dilutions necessary for analysis of the high levels of BTEX compounds present in groundwater. MTBE concentrations as high as 4.6 ppm have been detected as recently as June 2002 (Appendix B of Ref. 1). The maximum detected concentration of naphthalene in December 2002 was 130 parts per billion (ppb).

References:

1. Final RCRA Facility Investigation Report; Phillips Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated July 1999.
2. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.

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:

Significant effort has been expended to define the limits of the BTEX contamination at the facility and demonstrate the stability of the three BTEX Plumes. These efforts have included the completion of 431 GeoProbe™ borings and installation of 89 upper alluvial and 25 low alluvial monitoring wells (Ref. 1). The RFI provides a characterization of the basic site hydrogeology and a general delineation of groundwater contamination in on- and off-site areas. The results of these investigations are documented the July 1999 RFI Report (Ref. 2). After completion of the RFI investigations, a series of additional investigations were implemented beginning in 1999 to better characterize and delineate the downgradient portions of the contaminant plumes emanating from the site. These additional investigations include a series of GeoProbe™ investigations, surface water and sediment sampling, and the installation and sampling of additional monitoring wells in the downgradient areas of the contaminant plumes. These investigations are documented in the May 2003 CMS Related Investigations Report (Ref. 1).

The additional, post-RFI investigations were specifically designed to identify and monitor potential contaminant migration pathways, particularly in the upper alluvial unit, for the three off-site plumes present at the facility. Investigation results clearly indicate that contaminant migration is controlled by the presence of higher permeability sands lenses and that the configuration of the plume correlates strongly with the presence of these units. These investigations were conducted in an iterative manner. GeoProbe™ investigations were used to delineate these sand units and to determine the extent of contamination within them. Based on the findings of the GeoProbe™ investigation, permanent monitoring wells have been installed within these sands at the periphery of the plume to provide measurements of groundwater quality in the downgradient areas of the plumes on a continuing basis. GeoProbe™ investigations were also conducted to determine if the envelope of the filled ditch containing the PRASA effluent pipe (the PRASA Ditch) that runs along the eastern boundary of the facility is acting as a migration pathway for the eastern and southeastern upper alluvial plumes. Based on these investigations, permanent monitoring wells were installed along the PRASA Ditch to provide ongoing monitoring of this potential migration pathway. A summary of these post-RFI investigations is available in the May 2003 CMS Related Investigations Report (Ref. 1).

In addition to these investigation results, the results of an ongoing program of continued monitoring are

[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.

available to demonstrate the stability of the groundwater contamination at the facility. CPCPRC has performed five years of monitoring on a semi-annual basis from monitoring wells in both on- and off-site areas of the facility. These data are presented in their entirety as Appendix B of the May 2003 CMS Related Investigations Report (Ref. 1). CPCPRC has also conducted extensive sampling and analysis of natural attenuation parameters, both during the initial investigations and as part of its ongoing semi-annual monitoring program, to further support the demonstration of plume stabilization. The analysis of natural attenuation performed on the site is consistent with U.S. EPA guidance on the use of monitored natural attenuation (MNA) at RCRA facilities (Ref. 3). The analysis of natural attenuation focused first on the review of contaminant data collected over a period of years demonstrating plume stability. The analysis of natural attenuation also included the collection of analytical data for relevant natural attenuation parameters that clearly identify the biodegradation processes occurring on site and provide estimates of the biodegradation capacity available at the site. Estimates of biodegradation capacity were calculated in a manner consistent with available MNA guidance (Ref. 4). These data and analyses are fully presented in the May 2003 CMS Related Investigations Report (Ref. 1). The results of a series of GeoProbe™ studies conducted between 1996 and 2001 are also available for establishing the configuration of the plumes over an extended period of time. These data, combined with data from the ongoing semi-annual monitoring program, provide the basis for examining the stability of the downgradient extent of the plume over the past five years.

In addition to these characterization and monitoring activities, CPCPRC has instituted several interim remedial measures designed to help stabilize the groundwater contamination. Since 1996, CPCPRC has implemented a Free Product Management Plan (Refs. 5, 6) that has focused on recovering LNAPL and associated dissolved phase contaminants using enhanced fluid recovery (EFR™) and includes a tank inspection and repair program. EFR is an in-situ technology that uses elevated air extraction rates and vacuum pressure to remove multiple phases (i.e., vapor, dissolved, adsorbed, and liquid) of VOCs. EFR also stimulates aerobic biodegradation by increasing the supply of oxygen in the subsurface. EFR has been applied to monitoring wells and specially installed recovery wells located in known areas of LNAPL contamination and in areas of high dissolved BTEX concentrations. This program has been effective in removing large amounts of contaminants and continues to be implemented by the facility. Further discussion of this remedial program is available in the Free Product Management Plan (Ref. 5) and the May 2003 CMS Related Investigations Report (Ref. 1). CPCPRC has also installed an air sparging trench along the eastern boundary of the facility to control the migration of LNAPL and dissolved petroleum constituent across eastern boundary of the facility.

The data and analyses that demonstrate the stability of contaminant plumes in the upper and lower alluvial aquifers are discussed separately below.

Upper Alluvial Aquifer

Groundwater quality data reported in the 1999 RFI Report (Ref. 2) have indicated that the eastern perimeter, southeast corner, and west cane field plumes have been present in the upper alluvial unit at least since the early 1990s. Thus, historical data are useful for demonstrating the stability of the areal extent of these plumes, particularly in the absence of any significant, observed increases in contaminant concentrations in the source areas. Because benzene is the predominate contaminant in the BTEX plumes, benzene data are used to depict the historical configuration of the three plumes in the upper alluvial unit. The configuration of each plume, including distribution of contaminants within the three plumes, as of December 2002, is shown on Plate 6 of the May 2003 CMS Related Investigations Report (Ref. 1). This depiction clearly shows the current horizontal extent of the benzene plume. The non-detect (ND) analytical values clearly show the limit of contaminant migration in all three plumes.

The distributions of benzene in the upper alluvial unit in the west cane field, southeast perimeter, and southeast corner in December 1999 are shown, respectively, in Plates 3, 4, and 5 of the May 2003 CMS Related Investigations Report (Ref. 1). In addition to data from monitoring wells, Plates 3, 4, and 5 show groundwater quality data obtained from GeoProbe™ investigations conducted in 1996, 1997, 1998 and

1999. A comparison of the configuration of the plumes depicted on these plates with those depicted for May 2003 show that the configuration has not changed between these periods. Thus, the downgradient extent of all the plumes has not changed over the past three years.

Trends in groundwater quality data are also available to support a demonstration that the groundwater contaminant plumes at the site are stabilized. A discussion of historical trends in groundwater quality data, including numerous graphs showing the observed trends, is available in the May 2003 CMS Related Investigations Report (Ref. 1). Historical data from wells located in the source area for the southeast perimeter plume (wells MW-24 and MW-17R) indicate a steady decrease in source concentrations in recent years. Groundwater quality data from off-site wells located downgradient (east and southeast) of the source area for this plume have consistently indicated little or no measurable contamination. Historical data from wells located in the source area for the southeast corner plume (wells MW-5R and MW-16) also indicate a steady decrease in source concentrations in recent years, with MW-5R decreasing from 390 ppm in July 1999 to 0.018 ppm in December 2002 and MW-16 decreasing from 100 ppm in June 1999 to non-detect in December 2002. MW-16 has been below detectable levels in five of the last six sampling events. Groundwater quality data from off-site monitoring wells located immediately downgradient from the southeast corner of the facility have consistently indicated no measurable benzene, with the exception of sporadic low-level detections between 1994 and 1999. The reductions in source concentrations along the southeast perimeter and southeast corner are likely due to the Free Product Management Plan implemented by the facility.

Along the western border of the facility, adjacent to the source areas for the west cane field plumes, historical data have indicated variable levels of contaminants, but with generally decreasing trends along the northern and central portion of the western facility border (wells MW-104 and MW-158). Benzene concentrations along the southern portion of the western facility border remain high (MW-28), but within historical levels observed since July 1998. The program of EFR has recently been intensified in this area to further control the contamination along the southern portion of the western facility border. Recent trends in off-site wells within the interior of the plume are not available because construction of the AES facility resulted in the abandonment of these wells in early 2000. However, the sampling of perimeter wells support stability by indicating non-detect or trace concentrations of benzene since their installation in early 2002.

The historical groundwater quality data clearly indicate that the groundwater plumes are not increasing in size and are stable. An analysis of natural attenuation data consistent with EPA guidance (Refs. 3,4) has been performed to evaluate the relative role of natural attenuation, particularly biodegradation, in stabilizing the contaminant plume in groundwater. Water quality data for natural attenuation parameters indicate that the biodegradation of the BTEX plumes likely plays a significant role in limiting the downgradient migration of the BTEX plumes, particularly in the former west cane field. Natural attenuation parameter data indicate that the geochemical environment is heavily reducing within the plume and that methanogenesis is likely contributing significantly to the biodegradation occurring within the plume. Methane levels as high as 1,200 mg/l have been observed in groundwater in the former west cane field. Methanogenesis is a self-perpetuating biodegradation process that can control BTEX concentrations if sufficient time is available. The historical groundwater quality data indicate that methanogenesis combined with other natural degradation and attenuation processes have likely reached an equilibrium with the BTEX migrating from the source areas such that the plumes have reached equilibrium and are no longer expanding. Based on an analysis of all biodegradation parameter data, a maximum biodegradation capacity of 1,688 mg/l of benzene has been estimated. This biodegradation capacity exceeds the benzene concentrations observed in any of the source areas. A discussion of the natural attenuation parameter data and the fate and transport of the plume is presented in greater detail in the May 2003 CMS Related Investigations Report (Ref. 1).

It is also important to note that in addition to the biodegradation capacity, the potential discharge of the plumes along the southeastern boundary of the facility into the effluent channel running along the southern boundary of the facility may also contribute to limiting the growth of the plumes on the eastern

side of the facility. The PRASA ditch may also channel contaminants in the southeast perimeter plume southward towards the effluent channel where it may commingle with the southeastern corner plume and discharge with that plume into the effluent channel.

Thus, the historical data indicating the stability of the areal extent of the BTEX plumes, combined with the favorable trends in BTEX concentrations, the apparent biodegradation capacity of the upper alluvial units, and the potential control of migration provided by the effluent channel convincingly demonstrate that the BTEX plumes in the upper alluvial unit are not currently expanding and are stable. Groundwater quality data for other petroleum related contaminants in the upper alluvial aquifer, most importantly MTBE and naphthalene, similarly support this conclusion. It is important to note that while MTBE may not readily biodegrade in some geochemical environments, research has shown that MTBE readily biodegrades in heavily reducing environments in which methanogenesis is occurring (Ref. 7). Such a geochemical environment has been clearly demonstrated to be present at the CPCPRC facility.

Lower Alluvial Aquifer

The lower alluvial sand unit is present beneath the entire facility, ranging in thickness from about 14 to 62 feet, and extending to the top of bedrock. In the central portion of the facility, the lower alluvial sand unit lies directly below the upper alluvial sand unit and is hydraulically connected with the upper sand unit. In the southern portion of the facility, the upper and lower sand units are separated by a shallow aquitard and lagoon deposits. The two units are generally hydraulically isolated in the southern portion of the facility but some degree of hydraulic interconnection may exist in localized areas. There are generally downward gradients from the upper to the lower alluvial units in the northern and central portion of the facility, but upward gradients predominate in the southern portion of the facility. The source of contamination in the lower alluvial aquifer is primarily downward migration of dissolved constituents from source areas in the central portion of the facility where the aquitard separating the upper and lower aquifers is absent and downward hydraulic gradients are generally present. Due to the depth or the lower alluvial aquifer of approximately 20 feet below the water table, LNAPL is not likely to have migrated into the lower alluvial unit (Ref. 2).

The distribution of benzene in the lower alluvial unit in December 2002 is shown in Figure 4-3 of the May 2003 CMS Related Investigations Report (Ref. 1). As shown in this figure, very few detections of benzene have recently been observed in the lower alluvial unit and these detections indicate only minimal benzene remaining in the lower alluvial unit. Figure 4-3 clearly demonstrates that the current limits of BTEX contamination have been delineated by recent monitoring. The distribution of benzene in the lower alluvial unit in December 1999 is shown in Figure 4-2 of the May 2003 CMS Related Investigations Report. As Figure 4-2 indicates, notable concentrations of benzene were observable locally within the lower alluvial aquifer in December of 1999. Comparison of the plume in the lower alluvial unit in December of 1999 and 2002 reveals marked decreases in concentrations through the lower alluvial unit between these dates. For example, the concentration of benzene in MW-129D, which is located along the southern border of the facility, has dropped from 63 mg/l to non detect (ND) in December 2002. Similarly, MW-21D, which is located in the southeast corner of the facility has dropped from 59 mg/l to 0.039 mg/l from December 1999 to December 2002. As indicated by this comparison, examination of historical benzene and other BTEX constituent concentration data at individual wells located throughout the lower alluvial aquifer clearly show decreasing trends in BTEX concentrations, with only traces of benzene remaining in the lower alluvial aquifer. Further discussion of historical trends in groundwater quality data, including numerous graphs showing the observed trends, in the lower alluvial unit is available in the May 2003 CMS Related Investigations Report (Ref. 1).

The May 2003 CMS Related Investigations Report (Ref. 1) also presents an analysis of the natural biodegradation capacity of the lower alluvial unit. This analysis is consistent with existing MNA guidance (Refs. 3, 4) and appears to indicate sufficient biodegradation capacity to remove the levels of BTEX previously observed in the lower alluvial unit. Consequently, biodegradation and facility efforts to

control and remediate releases from the facility tank farms through EFR are thought to have been responsible for the removal of BTEX contaminants from the lower alluvial unit.

The analysis of historical groundwater quality data, including recent monitoring data, indicates that the BTEX plume in the lower alluvial unit is not only stable but is also contracting in size. Groundwater quality data for other petroleum related contaminants in the lower alluvial aquifer, most importantly MTBE and naphthalene, similarly support this conclusion. The plume appears to be dissipating before discharging into any surface water body (i.e. Caribbean Sea).

References:

1. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.
2. Final RCRA Facility Investigation Report; Phillips Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated July 1999.
3. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. U.S. EPA OSWER Directive 9200.4-17P. Dated April 1999
4. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater. Air Force Center for Environmental Excellence. Dated 1995.
5. Free Product Management Plan; Phillips Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated March 1996.
6. Free Product Management Plan Update; Phillips Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated September 1996.
7. Natural Attenuation of MTBE in the Subsurface under Methanogenic Conditions; U.S. EPA Office of Research and Development, EPA/6000/R-00/006. Dated January 2000.

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:

Plate 6 of the May 2003 CMS Related Investigations Report (Ref. 1), which depicts the benzene plume in the upper alluvial unit in December 2002, shows the benzene plume extending beneath the effluent channel in the southeast corner of the facility. Groundwater quality measurements are not available to confirm the actual extent and nature of the BTEX plume immediately adjacent to the channel. However, it is reasonable to assume that some portion of the BTEX plume in this portion of the facility discharges to this channel. The effluent channel is an unlined ditched which intersects the water table and is currently used for NPDES and stormwater discharges. The channel begins at the southeastern corner of the facility and flows westward to discharge into the Las Mareas Harbor. Although groundwater quality data indicate that the benzene plume may have dissipated in the southeast corner of the facility (see MW-5R and MW-16 on Plate 6), groundwater quality data (GP-401) have recently indicated that BTEX constituents may continue to migrate southward along the PRASA ditch from the southeastern perimeter plume to the southeast corner of the facility where some portion of the plume likely discharges to the effluent channel. However, groundwater quality and the analysis of natural attenuation and degradation parameter data consistent with existing MNA guidance (Refs. 2,3) indicate that any BTEX contamination that passes beneath the effluent channel and/or around eastern end of the channel is biodegraded (see Question 3).

References:

1. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.
2. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites. U.S. EPA OSWER Directive 9200.4-17P. Dated April 1999
3. Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater. Air Force Center for Environmental Excellence. Dated 1995.

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 its 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)?

____ 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 "levels," 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.

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

Rationale:

Due to density of the monitoring well network and the measured concentrations within the BTEX plume in the southeast corner of the facility that change quickly along the direction of downgradient flow, it is difficult to directly assess the concentrations of benzene and other BTEX parameters in groundwater that actually discharges to the effluent channel. The extrapolated concentration contours depicted in Plate 6 of the May 2003 CMS Related Investigations Report (Ref. 1), which depicts the benzene plume in the upper alluvial unit in December 2002, indicates that the concentration of benzene may be as high as 100 ppm. However, this depiction represents a worst case scenario, and recent groundwater monitoring data in the southeast corner of the facility has identified only trace amounts BTEX. The Ambient Water Quality Criteria for benzene range from 700 ppb (marine) to 5300 ppb (freshwater) for lowest observable effect level. The effluent channel begins as a largely freshwater body but shortly discharges in the Las Mareas harbor, which is a salt water body. Thus, the benzene levels potentially discharging into the effluent channel may have exceeded surface water criteria by more than a factor of 10. However, as noted in the response to Question 6, current surface water quality data indicate that benzene and other BTEX compounds are having no observable impact on the effluent channel.

References:

1. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.

[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 ecosystems 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 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), which 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:

The effluent channel has undergone semi-annual monitoring of both surface water and sediments since June 1998. Surface water and sediment sample locations are shown on Plate 1 of the May 2003 CMS Related Investigations Report (Ref. 1). These sampling locations include a location at the eastern end of the effluent channel where the BTEX plume would discharge. At SW-NPDES3 (the sample location closest to the likely discharge area of the plume) benzene has only been detected once in surface water (7.4 µg/l). Benzene has not been found in the channel at this location since 1998. Other BTEX constituents and MTBE have never been detected in surface water at SW-NPDES3. In sediments, benzene was detected only once at the upstream sample location adjacent to the plume discharge area (SW-NDES3, 700 µg/kg in June 1998), and has not been detected since. Thus, it is reasonable to conclude that any potential discharges of BTEX contamination from groundwater to the effluent channel is minimal and currently acceptable. A more detailed discussion of surface water and sediment sampling, including a tabular presentation of the data, is available in the May 2003 CMS Related Investigations

[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, an 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.

Report (Ref. 1).

References:

1. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 2003.

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 that 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:

Since June of 1998, CPCPRC has implemented a semi-annual program for sampling groundwater, surface water, and sediments. An extensive list of relevant VOCs, SVOCs, and metal constituents are analyzed during each sampling event. This program includes 42 locations where groundwater quality samples are taken from the upper alluvial aquifer, and 24 locations in the lower alluvial aquifer. These monitoring locations are along the periphery of the facility and in the off-site areas of the plumes, including areas immediately downgradient from the known extent of the plume. These locations are well suited for verifying the continued stability of the BTEX plumes. Figures 2-1 and 2-2 of the May 2003 CMS Related Investigations Report (Ref. 1) show the locations of these monitoring wells. Surface water and sediment samples are taken from the three locations shown on Plate 1 of the May 2003 CMS Related Investigations Report (Ref. 1). CPCPRC will continue this program to ensure that groundwater contamination associated with the site remains stable. A more detailed discussion of the semi-annual monitoring program is available in the May 2003 CMS Related Investigations Report (Ref. 1).

References:

1. CMS-Related Investigations Report; CPC Puerto Rico Core, Inc., Guayama, Puerto Rico. Prepared by CH2MHill. Dated May 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 "Migration of Contaminated Groundwater" is "Under Control" at the Chevron Phillips Chemical Puerto Rico Core, Inc. (EPA ID# PRD991291972), located at Road #710 and State Route #3, Guayama, Puerto Rico. Specifically, this determination indicates that 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:_____

Richard Kuhlthau, Ph.D.
Senior Groundwater Hydrologist
Booz Allen Hamilton

Reviewed by: _____ Date:_____

Connie Crossley
Senior Geologist
Booz Allen Hamilton

Also Reviewed by: _____ Date:_____

Sam Ezekwo, RPM
RCRA Programs Branch
USEPA Region 2

_____ Date:_____

Dale Carpenter, Section Chief
RCRA Programs Branch
USEPA Region 2

Approved by: Signed by_____ Date: 9/25/2003

Adolf Everett, Acting Chief
RCRA Programs Branch
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 EPA Region 2, RCRA Records Center, located at 290 Broadway, 15th Floor, New York, New York.

Contact telephone and e-mail numbers: Sam Ezekwo, USEPA RPM
(212) 637-4168
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Attachments

- Attachment 1 - Summary of Media Impacts Table

Attachment 1 - Summary of Media Impacts Table
Chevron Phillips Chemical Puerto Rico Core, Inc., Road #710 and State Route #3, Guayama, Puerto Rico 00655

OU	GW	AIR (Indoors)	SURF SOIL	SURF WATER	SED	SUB SURF SOIL	AIR (Outdoors)	CORRECTIVE ACTION MEASURE	KEY CONTAMINANTS
Groundwater Contamination (Southeast Perimeter Plume, Southeast Corner Plume, and West Cane Field Plume)	Yes	NA						• Free Product Management Plan for LNAPL and Enhanced Fluid Recovery for dissolved phase contamination • Semi-annual monitoring program for groundwater, surface water, and sediments • Natural attenuation	Petroleum hydrocarbons including BTEX, MTBE, and naphthalene