DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

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

Facility Name: **Shell Chemical Yabucoa, Inc.**
Facility Address: **Route 901, Km 2.7, Camino Nuevo Ward, Yabucoa, Puerto Rico**
Facility EPA ID #: **PRD090074071**

1. Has **all** available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

   _X_ If yes - check here and continue with #2 below.

   _____ If no - re-evaluate existing data, or

   _____ If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

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

Definition of "Migration of Contaminated Groundwater Under Control" EI

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

Relationship of EI to Final Remedies

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

Duration / Applicability of EI Determinations.

EI Determinations status codes should remain in 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 Description:

Shell Chemical Yabucoa Inc. (SCYI) is a petroleum refining facility located in Yabucoa, Puerto Rico. A description of the facility is presented below.

Site Location and Setting

The SCYI facility is located on Route 901, Km 2.7, Camino Nuevo Ward, about 1.5 miles east of the town of Yabucoa, Puerto Rico. The facility occupies an area of approximately 252 acres, which is sub-divided into three working areas: the Refinery Area, the Tank Farm Area, and the Dock Area. The Refinery Area is the most inland area of the facility; the Tank Farm Area is about 2,300 ft east toward the Caribbean Sea; and the Dock Area is further to the east and terminates at the Caribbean Sea. The Dock Area encloses a small man-made inlet (usually referred to as the Turning Basin), which the facility uses for sea transportation purposes.

Agricultural and sugar cane fields surround the facility to the north, east, and west. Route 901 borders the Refinery Area to the south. Route 53 traverses between the Refinery and Tank Farm Areas. Sugar cane fields are to the south of the Tank Farm Area and a palm tree grove and beach are to the south of the Dock Area. A mountainous area is situated further south of the facility.

The nearest populated area to the facility is the residential community of Camino Nuevo, which has a population of about 4,900, the center of which is located about 2,500 ft southeast of the Refinery Area. The city of Yabucoa is located about 1.5 miles west of the facility.

The nearest surface water features to the facility are Lajas Creek, which runs along the eastern border of the Refinery Area, and Santiago Creek, which runs along the northern border of the Refinery Area. Lajas Creek subsequently enters Santiago Creek about 300 feet north of the Refinery Area. Santiago Creek runs eastward along the northern part of the Refinery Area and discharges to the Caribbean Sea about 1.5 miles to the east and north of the Dock Area. A small unnamed creek runs generally east-west near the northern border of the Tank Farm Area. This creek is also a tributary to Santiago Creek. A second small unnamed creek runs in a northeasterly direction south of the Tank Farm Area. This creek discharges directly to the Caribbean Sea. None of the rivers or streams in the valley is navigable by large vessels.

The largest surface water body in the area is the Caribbean Sea which borders the Dock Area and is about 1.5 miles east of the Refinery Area. In the Dock Area, the Turning Basin, which is a man-made inlet from the Caribbean Sea, is used by tanker ships for loading/unloading operations.

SCYI's current water well production field consists of four wells and extends from about 2300 to 7000 ft north to northwest of the Refinery Area. There are no on-site water supply wells. No municipal or other water supply wells are located downgradient of the facility.

Facility Operations

Petroleum refining operations at the facility commenced in May 1971. Prior to the construction of the facility, the property was used as agricultural land. SCYI leases the property upon which the facility is constructed from the Commonwealth of Puerto Rico. SCYI purchased the facility on December 31, 2001 from Puerto Rico Sun Oil Company (an entity of Sunoco, Inc.), which was the prior operator. There have been no other owners of the facility.

The facility has the capacity to process 85,000 barrels per day of crude oil. Major products include gasoline, kerosene, light distillates, naphtha, jet fuel, diesel fuel, No. 6 fuel oil, heavy olefin feedstock, residual fuels, and sulfur. Operations at the SCYI facility are conducted at the three distinct areas interconnected by a series of above ground pipelines. Further information on each of the areas is provided below.

> Refinery Area - The Refinery Area includes SCYI's oil processing operations. The following main process units are operated at the Refinery Area: desalter, atmospheric distillation unit, vacuum distillation unit, catalytic gasoline

reformer, high-pressure hydrotreater, sulfur unit, and utilities. The Refinery Area also includes tank storage facilities, administrative and maintenance operations and a waste storage and treatment facility. The Refinery Area Wastewater Treatment Plant is located in the northern portion of the Refinery Area.

Tank Farm - Raw materials and products manufactured by SCYI are stored in above ground steel tanks in the Tank Farm Area. The Tank Farm contains approximately 43 crude and product tanks, ranging in size from 500 to 375,000 barrels. A tanker truck loading rack is located near the southwestern corner of the Tank Farm. The Tank Farm Wastewater Treatment Plant is located in the southeast corner of the Tank Farm.

Dock Facility - SCYI operates a dock facility for the loading and unloading of crude oil and products. The facility includes a Main Dock that serves oil tankers and a Barge Dock that serves smaller vessels and barges. There is also a dock for the servicing of tugboats. Crude oil and products are transferred to and from the Dock Area via aboveground pipelines. There are no storage facilities or process units at the Dock Area.

The SCYI facility is served by several different wastewater collection and treatment systems. The systems are designed to reduce the volume of contaminated wastewater requiring treatment by segregating contaminated and uncontaminated wastewater to the maximum extent possible. At the Refinery Area, collection systems exist for contaminated process wastewater, contaminated storm water, uncontaminated storm water, and sanitary wastewater. At the Tank Farm, a collection system is provided for storm water and tank water draw-off. Collection systems are provided for storm water at both the Main Dock and the Barge Dock. SCYI has been issued a National Pollution Discharge Elimination System (NPDES) Permit for the discharge of wastewater and storm water into area surface waters. The Permit allows the discharge of treated process wastewater into the Caribbean Sea through Outfall 001 and the discharge of uncontaminated storm water into Santiago Creek through Outfall 002.

RCRA Hazardous Waste Management Program

SCYI generates a number of wastes regulated as hazardous under RCRA as part of its operation, primarily the following:

F037 - Petroleum Refinery Primary Oil/Water/Solid Separation Sludge
F038 - Petroleum Refinery Secondary Oil/Water/Solid Separation Sludge
K048 - Dissolved Air Flotation (DAF) Unit Float
K049 - Slop Oil Emulsion Solids
K050 - Heat Exchanger Bundle Solids
K051 - API Separator Sludge
K069 - Crude Oil Tank Sediment
K171 - Spent Hydrotreating Catalyst
K172 - Spent Hydrorefining Catalyst
D001 - Ignitable Waste
D002 – Spent Mercury Sulfate & Sulfuric Acid (COD vials)
D008 - Lead containing spent car batteries
D009 - Mercury containing fluorescent lamps
D001, D002, D005, D006, D007, D008 - Expired laboratory reagents (Lab packs)
D018 - Toxic (Benzene) Waste (i.e., benzene contaminated spent catalyst from gasoline reformer unit)
U154 - Methanol Waste (Off-Specification)

SCYI operates a container storage area (CSA) under interim status for the storage of hazardous waste prior to off-site disposal. EPA has approved SCYI's RCRA Part B Permit Application for expansion of the CSA and has prepared a draft RCRA Permit for operation of the unit. Final issuance of the permit is pending final EPA approval.

Two regulated hazardous waste surface impoundments were formerly operated at the facility: the Equalization Basin at the Refinery Area and the New Oily Sludge Basin at the Tank Farm. The units have undergone RCRA closure. EPA approved clean closure of the units in June 2002.

SCYI does not operate any other regulated hazardous waste management units.

RCRA Corrective Action Program

A RCRA Facility Investigation (RFI) has been completed at the SCYI facility. The RFI was implemented to satisfy the terms of the RCRA 3008(h) Corrective Action Order (Order) signed by PRSOC, the previous facility owner, and the United States Environmental Protection Agency (EPA) in June 1994.

The RFI was conducted in accordance with the terms of the RCRA Facility Investigation Work Plan, which was approved by EPA, with certain revisions, in April 1996. The RFI included the investigation of soil and/or groundwater at 16 solid waste management units (SWMUs) identified in the Order. A summary and description of the SWMUs subject to the RFI is presented in Attachment 1. Attachment 2 contains a list of SWMUs at the facility that were not subject to the RFI. A facility map depicting SWMU locations was presented as Figure 5-1 in the March 2005 Final RFI Report (Ref. 3), and is provided with this EI determination as Attachment 3. The objectives of the RFI were to identify hazardous constituents and their concentrations in soil and/or groundwater at the subject SWMUs, to determine the potential for contaminant migration, to acquire sufficient data to characterize environmental contamination at the SWMUs to support interim or long-term corrective measures, and to acquire sufficient data to assess any risk to human health and the environment.

Initial RFI field activities were conducted between June and August 1996 with certain follow-on activities conducted in January 1997. A Draft RFI Report (Ref. 1) was submitted to EPA in June 1997. In response to EPA comments on the Draft RFI Report, PRSOC submitted a Supplemental RFI Work Plan in March 1999, with subsequent revisions. Supplemental RFI field activities were conducted between January and June 2003. A Supplemental RFI Report (Ref. 2), which presented the results of the supplemental investigation, was submitted to EPA in June 2003. Additional field sampling activities were conducted in 2004 and 2005 in response to EPA comments. A total of 91 soil samples were collected for VOC, BNA and/or metals analysis. Eight soil samples were collected for physiochemical analysis. The soil samples were collected from various depths at 68 locations. A total of 58 groundwater monitoring wells were installed. The wells were used for groundwater level observations, collection of groundwater samples, and/or free-phase hydrocarbon (FPH) delineation and thickness measurements.

A Final RFI Report (Ref. 3), which consolidated the findings presented in the 1997 Draft RFI Report, the 2003 Supplemental RFI Report, and additional field investigation activities conducted in 2004, was submitted to EPA in March 2005. The report was reviewed by EPA and comments were issued in a letter dated August 17, 2005. SCYI is currently preparing responses to address EPA's comments.

In addition to the RFI, a Process Sewer Assessment was performed at the facility in accordance with the terms of the Order. The objective of the process sewer assessment, which consisted of a closed circuit television survey and soil sampling, was to determine whether hazardous constituents had been released from the sewer system. The study found no evidence of significant releases. The report for the Process Sewer Assessment (Ref. 4) was submitted to EPA in October 1997 and was subsequently approved by EPA.

A groundwater investigation of the Wastewater Treatment Plant/Maintenance Building Area (Refinery Area) was performed from 2001 through 2004 for the purpose of investigating a dissolved-phase vinyl chloride plume of limited extent. The presence of vinyl chloride was attributed to it being a biodegradation product of trichloroethene. Groundwater sampling for VOCs was performed at 13 direct-push locations, at four existing wells, and at two wells installed for the investigation. The results, which were reported to EPA in March 2005 (Ref. 5), concluded the lack of significant contamination. In May 2005, EPA concurred and agreed to termination of the investigation (Ref. 6).

The current status of the Corrective Action Program can be summarized as follows:

- The RFI and Process Sewer Assessment as required by the Order have been completed. EPA has approved the Process Sewer Assessment Report. As discussed above, SCYI is currently preparing responses to EPA's recently received comments to the Final RFI Report submitted in March 2005.

- Recovery of light non-aqueous phase liquids and/or routine groundwater monitoring is ongoing at a six SWMUs as described in Item 2.

- The need for further remediation at the site will be assessed as part of the Corrective Measure Study to be implemented after EPA approval of the Final RFI Report.

References:

1. Anderson, Mulholland & Associates, Inc. (AMAI), 1997. Draft RCRA Facility Investigation Report, Puerto Rico Sun Oil Company, Yabucoa, Puerto Rico.

2. Anderson, Mulholland & Associates, Inc. (AMAI), 2003. Supplemental RCRA Facility Investigation Report, Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

3. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. Anderson, Mulholland & Associates, Inc. (AMAI), 1997. Process Sewer Assessment Report, Puerto Rico Sun Oil Company, Yabucoa, Puerto Rico.

5. Letter from Sunoco Inc. to EPA dated March 28, 2005. (Sunoco Inc., as previous owner of the facility performed the Wastewater Treatment Plant/ Maintenance Building Area groundwater investigation on behalf of Shell Chemical Yabucoa, Inc.)

6. Letter from EPA to Shell Chemical Yabucoa, Inc. dated May 24, 2005.

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

Groundwater elevation and flow direction maps were constructed from synoptic water level measurements collected during the RFI in September 1996 and April 2003 (Ref. 1). The data show that the general groundwater flow direction is to the north and northeast within the Refinery Area; to the east and northeast within the Tank Farm Area; and to the east and southeast within the Dock Area. Groundwater elevations at the site varied from about 1 ft above mean sea level (amsl) at the Dock Area to over 21 ft amsl in the Refinery Area. The depth to groundwater, which is affected mainly by topographic relief, varied from approximately 2 to 15 ft bgl. Seasonal water level variations at the Refinery Area are about 5 ft. The seasonal water level variation decreases in magnitude toward the Caribbean Sea where groundwater elevations are lower. The seasonal water level changes, which generally followed rainfall cycles, do not appear to significantly affect the groundwater flow direction. Average horizontal groundwater velocities were calculated to be about 0.01 ft/day in the Refinery Area, 0.07 ft/day in the Tank Farm Area, and 0.8 ft/day in the Dock Area.

The vertical hydraulic gradient at the Northeast Refinery Area (SWMU 40) varies seasonally between upward and downward, although the upward direction was more frequent (Ref. 1). In the Tank Farm Area, the vertical gradient at the East API Separator (SWMU 3) was downward. At the Watery Oil Separator (SWMU 43) also in the Tank Farm Area, the vertical gradient varied seasonally between upward and downward, although the downward direction was more frequent. Expected groundwater discharge to the Caribbean Sea suggests an upward vertical gradient in the Dock Area.

The four production water wells for the facility are the most downgradient water supply wells in Yabucoa valley (Ref. 1). However, based on the groundwater flow direction data for the facility, none of the production wells are located downgradient of the site. The wells are located north and north-northwest of the Refinery Area. The production well closest to the facility is located about 2300 ft north of the Refinery Area. No apparent effect on groundwater levels at the facility from the production well pumping is observed (Ref. 1).

Groundwater Sampling History

Groundwater samples were collected and analyzed for VOCs, BNAs, and/or metals at 58 monitoring wells as part of the RFI work during 1996-1997 and Supplemental RFI work in 2003 and 2005 (Ref. 1). (Metals samples from 1996-1997 were analyzed for dissolved metals. Metals samples from 2003 and 2005 were for total and dissolved metals). Figures provided as Attachments 4 and 5 show the network of RFI groundwater monitoring locations at the facility. The wells are situated such that they provide adequate downgradient coverage for evaluating the groundwater quality at the facility for RFI purposes, as well as for evaluating achievement of environmental indicators. Three of the wells are screened (10 ft screen length) in a deep water-bearing zone at the Refinery and Tank Farm areas at depths between 25 and 38 ft bgl. All other wells are screened at or near the top of the water table.

Quarterly groundwater sampling for VOCs has been performed at well MDS-4 of the Main Dock Sump (SWMU 33) since September 2003 as part of interim measures (Ref. 2).

Groundwater sampling for VOCs was performed during December 2001 to December 2002 for the Wastewater Treatment Plant/Maintenance Building Area groundwater investigation (Ref. 3). Quarterly groundwater sampling from March through December 2004 (Ref. 4) was also performed for VOCs for the Wastewater Treatment Plant/Maintenance Building Area groundwater investigation. As discussed in Item 1, the results were reported to EPA in March 2005 with a conclusion of lack of significant contamination. In May 2005, EPA concurred and agreed to terminate the investigation in this area.

Groundwater Results Summary

Groundwater results from the various phases of investigation were compared to groundwater screening levels to determine if additional investigation and/or corrective actions were warranted. Groundwater screening levels were obtained from EPA Maximum Contaminant Levels (MCLs) and, where MCLs were not available, EPA Region 3 risk-based concentrations (RBCs) for tap water (October 2004) were used. For MTBE, the acceptable drinking water guideline (20 to 40 ug/L) established by EPA (Ref. 5) was used. Texas Natural Resource Conservation Commission (TNRCC) protective concentration levels (TNRCC PCLs, March 2004) were used as groundwater screening levels for acenaphthylene (1,500 ug/L), benzo(ghi)perylene (73 ug/L), and phenanthrene (73 ug/L), because MCLs and Region 3 tap water RBCs were not available for these three compounds. For lead, the EPA action level of 15 ug/L was used as the groundwater screening level. The constituents of concern that exceeded groundwater screening levels, their maximum concentrations, and the location of the maximum detected concentration are shown in the table below. Attachments 4 and 5 show the locations at which these exceedances occurred.

Groundwater Contaminant	Screening Levels (ug/L)	Maximum Concentration (ug/L)	Location of Maximum
Benzene	5	5.1	Well MDS-4 (SWMU 33) – Dock Area (Ref. 2)
Naphthalene	6.5*	26.4	Well MDS-4 (SWMU 33) – Dock Area (Ref. 2)
2-Methylnaphthalene	24	60.1	Well MDS-4 (SWMU 33) – Dock Area (Ref. 1)
2-Methylnaphthalene	24	36.9	Well 40-21 (SWMU 40) – Refinery Area (Ref. 1)
Arsenic	10	34	Well BDS-2 (SWMU 34) – Dock Area (Ref. 1)
Arsenic	10	12.3 J	Well AB-1 (SWMU 17/18) – Refinery Area (Ref. 1)
Arsenic	10	10	Well WOS-5 (SWMU 43) – Tank Farm Area (Ref. 1)

Notes: * - indicates an EPA Region 3 tap water RBC. All other screening levels are EPA MCLs. The 'J' data qualifier indicates an estimated concentration. Benzene and naphthalene results at well MDS-4 are the most recent quarterly results from February 2005; the 2-methylnaphthalene result is from June 2003. The benzene, naphthalene, and 2-methylnaphthalene results at well MDS-4 may be biased high due to the presence of a free phase hydrocarbon sheen in the well prior to sample collection. Although the sheen was removed prior to sampling, the elevated results may be attributed to cross-contamination and may not be representative of actual groundwater quality in the area. The 2-methylnaphthalene result at well 40-21 is from February 2005. Arsenic is reported as total arsenic at wells BDS-2 and WOS-5, and as dissolved arsenic at well AB-1. Total arsenic at well AB-1 is not available. Arsenic at wells BDS-2 and WOS-5 is from April 2003. Arsenic at well AB-1 is from August 1996.

Groundwater sampling results from the Northeast Refinery Area (SWMU 40) showed only 2-methylnaphthalene above its screening level. Groundwater sampling results at the Main Dock Sump showed only benzene, naphthalene, and 2-methylnaphthalene above screening levels, although the actual presence of these dissolved phase constituents is questionable given the presence of a free product sheen in the well prior to sampling. Arsenic occurred above its screening level at the Aeration Basins (SWMUs 17 and 18) and at the Barge Dock Sump (SWMU 34). Arsenic was reported in groundwater at its screening level at the Watery Oil Separator (SWMU 43).

In addition to the dissolved phase contamination, petroleum hydrocarbon LNAPL was detected during the RFI at localized areas at six SWMUs: the Northeast Refinery Area (SWMU 40), East API Separator (SWMU 3), Watery Oil Separator (SWMU 43), East Aisle Ditch (SWMU 45), Main Dock Sump (SWMU 33), and Barge Dock Sump (SWMU 34) (Ref. 1). In December 2004, the maximum apparent LNAPL thicknesses at the various SWMUs were: 0.30 ft at the Northeast Refinery Area (SWMU 40), a sheen at the East API Separator (SWMU 3), 1.00 ft at Watery Oil Separator (SWMU 43), a sheen at the East Aisle Ditch (SWMU 45), 0.04 ft at the Main Dock Sump (SWMU 33), and a sheen at the Barge Dock Sump (SWMU 34) (Ref. 1). Maps showing the areal distribution and thickness of LNAPL at the various units are presented in Reference 1. The LNAPL plumes are stable and/or decreasing in size as discussed further in Item 3. Furthermore, SCYI has determined that the LNAPL is not a significant ongoing source of dissolved phase contamination in underlying groundwater.

Interim Measures for LNAPL in Groundwater

EPA-approved interim measures consisting of LNAPL thickness measurement and recovery have been ongoing at the six affected SWMUs discussed above since April 1997. The interim measures consist of weekly measurement and recovery at three SWMUs: Main Dock Sump (SWMU 33), Northeast Refinery Area (SWMU 40), and Watery Oil Separator (SWMU 43). Quarterly measurements and/or recovery is performed at the remaining three SWMUs where only a sheen is typically measured. These three SWMUs are the East API Separator (SWMU 3), Barge Dock Sump (SWMU 34), and East Aisle Ditch (SWMU 45). LNAPL thickness and recovery measurements are provided to EPA in RFI Quarterly Progress Reports.

References:

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

2. RFI Quarterly Progress Reports 38 through 44, for the quarterly periods corresponding to September-December 2003 through January-March 2005. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

3. Anderson, Mulholland & Associates, Inc. (AMAI), 2003. Groundwater Investigation Report, Wastewater Treatment Plant and Service Building Areas, SCYI Facility. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. RFI Quarterly Progress Reports 40 through 43, for the quarterly periods corresponding to January-March 2004 through October-December 2004. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

5. U.S. Environmental Protection Agency (EPA), 1997. Drinking Water Advisory: Consumer Acceptability Advice and Health Effects Analysis on Methyl Tertiary-Butyl Ether (MTBE). Office of Water. EPA-833-F-97-009.

Footnotes:

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, LNAPL 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).

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:

The primary concern for groundwater beneath the refinery is from dissolved-phase constituents and petroleum hydrocarbon LNAPL. Specific areas of impact are discussed below by SWMU designation.

HORIZONTAL MIGRATION

East API Separator (SWMU 3)

The East API Separator (SWMU 3) is located in the Tank Farm Area.

Groundwater sampling results at the East API Separator indicate no impact above screening levels for VOCs, BNAs, and/or metals, including at downgradient well 03-11 (Ref. 1). This demonstrates that groundwater at the south end of the unit has not been impacted by dissolved phase contamination.

Methylene chloride (48 ug/kg) was reported in soil at northern boring location 3-03 at the East API Separator (SWMU 3) above the migration to groundwater risk-based screening level of 20 ug/kg (Ref. 1). No monitoring wells are located directly downgradient of this soil sampling location, however, because the methylene chloride concentration does not significantly exceed its conservative migration to groundwater screening level, it is unlikely that this exceedance will result in significant and widespread groundwater impacts. Additionally, methylene chloride is a common laboratory contaminant and may not be reflective of actual soil conditions at this SWMU.

During initial RFI work in 1996 and 1997, LNAPL was observed only at well 03-09 at a maximum thickness of 0.77 ft (Ref. 1). In December 2004, only a sheen occurred at well 03-09, which shows a trend of decreasing thickness. LNAPL has not been detected at well 03-11, which is the downgradient monitoring well. The monitoring well network at the unit provides full delineation of the LNAPL plume. The trend of decreasing LNAPL thickness, the age of the plume, and absence of continuing sources indicate that the LNAPL plume at the East API Separator (SWMU 3) is stable or shrinking.

North and South Aeration Basins (SWMUs 17 and 18)

The arsenic level at well AB-1 (12 ug/L) downgradient of the North and South Aeration Basins (SWMUs 17 and 18) slightly exceeded its groundwater screening level of 10 ug/L (Ref. 1). Arsenic was not detected at well AB-2, downgradient of the North Aeration Basin (SWMU 17), or at wells 40-08, 40-11, and 40-12 of the Northeast Refinery Area (SWMU 40) which are also downgradient of well AB-1. Therefore, the arsenic contamination is localized near well AB-1 and does not appear to be migrating.

No LNAPL impact is observed at SWMU 18.

Main Dock Sump (SWMU 33)

The Main Dock Sump (SWMU 33) is located in the Dock Area adjacent to the Turning Basin.

Groundwater sampling results at the Main Dock Sump indicate no impact above screening levels for VOCs, BNAs, and/or metals from the LNAPL, with the exception of benzene, naphthalene, 2-methylnaphthalene at well MDS-4 (Ref. 2). Concentrations of these constituents with respect to their screening levels are presented in the response to Question 2. As stated previously, these sample results are believed to be biased high due to the presence of sheen in the well at the time of sampling. Although no monitoring wells were sampled downgradient of well MDS-4, none of the three groundwater constituents of concern (benzene, naphthalene, 2-methylnaphthalene) were detected in Caribbean Sea Inlet surface water directly downgradient of and adjacent to the unit (Ref. 1). Thus, the extent of groundwater contamination has been delineated and does not appear to be migrating at this time.

Arsenic (2.7 B ug/L) was detected in the surface water (seawater) adjacent to the Main Dock Sump at a level above the Puerto Rico Water Quality Standard of 1.4 ug/L. However, arsenic was not detected in the duplicate surface water sample, nor at concentrations above screening levels in groundwater at this SWMU. The detection of arsenic at the low level in the primary surface water sample may be due to instrument noise near the detection limit of 2.2 ug/L. Also, arsenic occurs naturally in seawater in concentrations generally ranging up to 2.6 ug/L (Refs. 4 and 5). Therefore, the arsenic level detected at the Main Dock Sump appears to be due to naturally occurring background levels or to laboratory instrument noise and need not be considered further in this EI determination.

LNAPL collected from the Main Dock Sump area during the RFI work in 1996 was characterized by fingerprint analysis to be severely degraded #4 fuel oil or a topped fraction of crude oil with a probable age of greater than 20 years (Ref. 1). During initial RFI work in 1996 and 1997, LNAPL was observed in a limited area at the unit. During that time, the maximum LNAPL thickness was 2.34 ft at well MDS-6. Subsequent releases at the unit from an adjacent above ground pipeline occurred in January 2002 and October 2003, and were appropriately reported to EPA. In December 2004, LNAPL thickness was reported up to 0.04 ft (Ref. 1), which indicates a trend of decreasing thickness. Although the most downgradient monitoring wells at this SWMU report the presence of LNAPL (sheen or measurable thicknesses), weekly visual inspections of the Turning Basin adjacent to the unit since January 2001 demonstrate the absence of LNAPL. Thus, the groundwater and surface water monitoring program at the area provides full delineation of the SWMU 33 LNAPL plume. No continuing sources are indicated.

The physical characteristics of the soil and groundwater at the Main Dock Sump area are summarized as follows: medium to coarse sand, mean tidal elevation of 0.5 ft, hydraulic conductivity of 76.2 m/day, hydraulic gradient of about 0.0001, total porosity of 0.30, estimated residual water saturation of 0.09, and an estimated field residual LNAPL saturation of 0.12. The physical characteristics and other observations for the LNAPL at the Main Dock Sump are summarized as follows: specific gravity of 0.87, estimated viscosity of 60 cSt, and an oil-air surface tension of 25 dynes/cm.

The trend of decreasing LNAPL thickness, the flat hydraulic gradient, 0.5 ft mean tidal elevation, the high LNAPL viscosity, and the age of the plume and absence of continuing sources indicate that the LNAPL plume is stable or shrinking (Ref. 2). A stable plume is confirmed by the fact that there has been no evidence of a release to the surface water during the RFI interim measures period.

Barge Dock Sump (SWMU 34)

The Barge Dock Sump (SWMU 34) is located in the Dock Area adjacent to the Turning Basin.

Groundwater sampling results at the Barge Dock Sump indicate no impact above screening levels for VOCs, BNAs, and/or metals, with the exception of arsenic at well BDS-2 (Ref. 1). In April 2003, the concentration of arsenic was 34 ug/L, which exceeded its screening level of 10 ug/L. However, the arsenic concentration in this well has dropped from a high of 55.2 ug/L (dissolved) when first measured in August 1996. Furthermore, downgradient well BDS-1 did not show arsenic concentrations above the screening level. Thus, the arsenic contamination is localized near the well and does not appear to be migrating.

During initial RFI work in 1996 and 1997, LNAPL was observed in a limited area at the unit (Ref. 1). During that time, the maximum LNAPL thickness was 0.49 ft at well BDS-3. However, in December 2004, only a sheen occurred at the unit, which shows a trend of decreasing thickness. The monitoring well network at the SWMU provides full delineation of the LNAPL plume, with no LNAPL indicated at downgradient wells BDS-5 and BDS-6 between the unit and the Turning Basin (among other wells around the SWMU). Therefore, the LNAPL plume at SWMU 34 appears to be stable or shrinking.

Northeast Refinery Area (SWMU 40)

The Northeast Refinery Area (SWMU 40) is located in the Refinery Area adjacent to Lajas and Santiago Creeks.

Groundwater sampling results at the Northeast Refinery Area (SWMU 40) indicate no dissolved phase impacts above screening levels for VOCs, BNAs, and/or metals, with the exception of 2-methylnaphthalene at well 40-21 (Ref. 1). The concentration of 2-methylnaphthalene was 36.9 ug/L, which exceeded its screening level of 24 ug/L. The sample was likely biased high due to the presence of sheen in the well at the time of sampling (February 2005). Surface water and sediment sample results from the adjacent Lajas Creek showed non-detect for 2-methylnaphthalene. Also, downgradient well 40-12 showed non-detect. Therefore, 2-methylnaphthalene contamination does not appear to be migrating in groundwater at this time.

The LNAPL at the Northeast Refinery Area is interpreted by fingerprint analysis to be severely degraded #4 fuel oil with a probable age of twenty years or more (Ref. 1). During the initial RFI work in 1996 and 1997, measurable LNAPL was observed in a limited area at wells 40-09, 40-10, and 40-11(Ref. 1). During that time, the maximum reported LNAPL thickness of 1.57 ft occurred at well 40-09. In December 2004, LNAPL thickness occurred up to 0.30 ft, which indicates a trend of decreasing thickness. Although the most downgradient monitoring wells at this SWMU report the presence of LNAPL (sheen or measurable thicknesses), weekly visual inspections of the adjacent Santiago (upgradient) and Lajas (downgradient) Creeks demonstrate the absence of LNAPL. Thus, the groundwater and surface water monitoring program at the area provides full delineation of the SWMU 40 LNAPL plume. No recent releases or continuing sources are indicated.

The physical characteristics of the soil at the Northeast Refinery Area are summarized as follows: silty clay loam, hydraulic conductivity of 0.122 m/d, hydraulic gradient of 0.012, total porosity of 0.43, estimated residual water saturation of 0.21, and an estimated field residual LNAPL saturation of 0.20. The physical characteristics and other observations for the LNAPL at the Northeast Refinery Area are as follows: specific gravity of 0.92, viscosity of 70.03 cSt, and an oil-air surface tension of 31.7 dynes/cm.

The trend of decreasing LNAPL thickness, the low hydraulic conductivity, the small difference between porosity and the combined residual water and LNAPL saturations of the soil, the high viscosity and surface tension of the LNAPL, and the age of the plume with no continuing sources are indicative of a stable or shrinking plume LNAPL plume (Ref. 2).

Watery Oil Separator (SWMU 43)

The Watery Oil Separator (SWMU 43) is located in the Tank Farm Area.

Groundwater sampling results at the Watery Oil Separator indicate no impact above screening levels for VOCs, BNAs, and/or metals (Ref. 1). However, the arsenic level at well WOS-5 was equal to its screening level of 10 ug/L. Because arsenic did not exceed its screening level at adjacent downgradient well WOS-4, the extent of any arsenic plume is limited. Due to the age of the plume and the limited area of impact, the arsenic contamination is localized near the well and does not appear to be migrating.

During initial RFI work in 1996 and 1997, LNAPL was observed in a limited area at well WOS-1 at a maximum thickness of 0.01 ft, and at well WOS-2 at a maximum thickness of 0.77 ft (Ref. 1). Characterization of the LNAPL at well WOS-2 by chemical fingerprinting showed a signature indicative of a severely degraded residual fraction of a crude oil or of a residual grade fuel oil. In December 2004, the thickness at well WOS-2 was 1.00 ft, and no LNAPL or sheen was observed at well WOS-1, which shows a generally stable thickness. LNAPL has not been detected at downgradient wells WOS-4A and WOS-5, indicating that the monitoring well network at this unit provides full delineation of the LNAPL plume. The generally

stable LNAPL thickness, the age of the plume, the absence of LNAPL at downgradient wells, and the absence of continuing sources indicate that the LNAPL plume at the Watery Oil Separator (SWMU 43) is stable.

East Aisle Ditch (SWMU 45)

The East Aisle Ditch (SWMU 45) is located in the Tank Farm Area.

Groundwater sampling results at the East Aisle Ditch indicate no impact above screening levels for VOCs, BNAs, and/or metals (Ref. 1). This demonstrates that groundwater at the unit has not been impacted by dissolved phase contamination.

During initial RFI work in August 1996, a localized sheen was observed at wells 45-01 and 45-10 (Ref. 1). The sheen was absent at the wells in subsequent observations, including during regularly scheduled interim measure observations since April 1997. A measurable LNAPL thickness greater than a sheen occurred only once at the East Aisle Ditch (0.06 ft at well 45-09 in June 2003). In December 2004, only a sheen was observed at well 45-09. The monitoring well network at the Tank Farm Area provides full delineation of the LNAPL plume. The negligible LNAPL thickness, the age of the plume, and absence of continuing sources indicate that the LNAPL plume at the East Aisle Ditch (SWMU 45) is stable or shrinking.

VERTICAL MIGRATION

The aquifer underlying the facility is comprised of a series of complex alluvial deposits consisting of coarse-grained stream channel deposits, finer grained natural levee deposits, and clay sized sediments typical of flood plain deposits. The alluvial deposits overlie crystalline bedrock comprised of diorite and granodiorite. Three deep wells were installed and sampled as part of Supplemental RFI Work in 2003. The wells are located at the following areas: well 40-14B at the Northeast Refinery Area (SWMU 40), well 03-10B at the East API Separator (SWMU 3), and well WOS-4B at the Watery Oil Separator (SWMU 43). The locations of the wells are shown on Figures 1 and 2. The depths of the wells ranged between 25 and 38 ft bgl.

Groundwater sampling for VOCs was performed at the deep wells as part of the Supplemental RFI work in April 2003 (Ref. 1). VOCs were selected, as they comprise the more mobile constituents. No VOCs were detected above screening levels. Therefore, there is no evidence of any impact to deep groundwater due to vertical contaminant migration.

References:

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

2. Huntley, D., and G.D. Beckett, (2002), Evaluating Hydrocarbon Removal from Source Zones and its Effect on Dissolved Plume Longevity and Concentration, American Petroleum Institute, API Publication 4715, September.

3. RFI Quarterly Progress Reports 38 through 44, for the quarterly periods corresponding to September-December 2003 through January-March 2005. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

4. World Health Organization (WHO), 2001, Arsenic and Arsenic Compounds, 2nd Edition, Geneva.

5. Turekian, K.K., 1968, Oceans, Prentice Hall, New York.

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:

The Northeast Refinery Area (SWMU 40), Main Dock Sump (SWMU 33), and Barge Dock Sump (SWMU 34) are the only units that are located adjacent to surface water bodies. The Northeast Refinery Area is situated adjacent to Santiago and Lajas Creeks. The Main Dock Sump and Barge Dock Sump are situated adjacent to the Turning Basin. Measurements for groundwater and surface water interaction at the Northeast Refinery Area (SWMU 40) generally show that surface water from Santiago Creek recharges the groundwater and that groundwater discharges to Lajas Creek (Ref. 1). Thus, potential groundwater to surface water discharges from these three SWMUs to Lajas Creek and/or the Caribbean Sea Inlet must be considered for purposes of this EI determination.

None of the groundwater exceedances reported at SWMU 34 were located adjacent to the Caribbean Sea Inlet. Thus, impacted groundwater does not appear to be discharging to surface water at this SWMU.

Monitoring wells 40-11, 40-12, 40-14, 40-17, and 40-21 are located immediately adjacent to Lajas Creek at the Northeast Refinery Area (SWMU 40). As presented in the response to Question 2, only well 40-21 reported exceedances of applicable groundwater standards (for 2-methylnaphthalene). In addition, LNAPL has been reported in wells 40-11, 40-12, and 40-21. Consequently, free product hydrocarbons (FPH) and/or groundwater impacted by dissolved phase constituents from the SWMU 40 area may be discharging to surface water in Lajas Creek.

Monitoring wells MDS-8, MDS-9R, and MDS-10R are located immediately adjacent to the Caribbean Sea Inlet at the Main Dock Sump (SWMU 33). Well MDS-4 is also located approximately 50 feet upgradient of the inlet; however, because no wells are situated between this well and surface water, contamination in this well must also be considered as potentially discharging to surface water. As presented in the response to Question 2, only well MDS-4 reported exceedances of applicable groundwater standards (for benzene, naphthalene, and 2-methylnaphthalene). In addition, LNAPL has been reported in six separate wells adjacent to surface water. Consequently, free product hydrocarbons (FPH) and/or groundwater impacted by dissolved phase constituents from the SWMU 33 area may be discharging to surface water in the Caribbean Sea Inlet.

Reference:

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration (3) of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

   _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 judgment/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

   ____ 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:

To assess the potential significance of contaminated groundwater discharges to surface water, groundwater contaminant concentrations directly upgradient of the affected surface water bodies are compared to applicable groundwater standards multiplied by a factor of ten to account for dilution, dispersion, and other factors which serve to reduce contaminant concentrations at the point of discharge into surface water. As shown below, none of the groundwater contaminant concentrations exceed applicable screening levels by more than a factor of ten. Thus, it does not appear that groundwater to surface water contaminant discharges are significant at this time.

Groundwater Contaminant	Screening Levels (ug/L)	Adjusted Screening Levels (ug/L)	Maximum Concentration (ug/L)	Location
Benzene	5	50	5.1	Well MDS-4 (SWMU 33)
Naphthalene	6.5	65	26.4	Well MDS-4 (SWMU 33)
2-Methylnaphthalene	24	240	60.1	Well MDS-4 (SWMU 33)
2-Methylnaphthalene	24	240	36.9	Well 40-21 (SWMU 40)

In addition, as part of Supplemental RFI (Ref. 1) work in February and March 2005, surface water samples were collected from Lajas Creek, which is adjacent to the Northeast Refinery Area (SWMU 40), and from the shoreline adjacent to the Main Dock Sump (SWMU 33). The surface water samples were analyzed for VOCs, BNAs, and/or metals. Sediment samples were also collected from Lajas Creek and analyzed for VOCs and BNAs.

None of the constituents (benzene, naphthalene, 2-methylnaphthalene) that were detected in the groundwater above screening levels at well MDS-4 of the Main Dock Sump (SWMU 33) were detected in the surface water adjacent to the unit (Ref. 1). Furthermore, 2-methylnaphthalene was not detected in the surface water or sediment from Lajas Creek, although it was detected in the groundwater above its screening level at adjacent well 40-21 in the Northeast

Refinery Area (SWMU 40) (Ref. 1). These results indicate that the surface water is not impacted from any contamination at these units.

Because localized LNAPL plumes occur at SWMUs 33 and 40, visual observations have been performed on a weekly basis since April 2003 in the surface water at Lajas and Santiago Creeks, which are adjacent to the Northeast Refinery Area (SWMU 40). Visual observations have also been performed on a weekly basis since January 2001 at the shoreline opposite the Main Dock Sump (SWMU 33). No sheen has been observed at any of the surface water monitoring locations (Ref. 1). Thus, it does not appear that LNAPL in groundwater is negatively impacting surface water quality at this time.

Reference:

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

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

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

_____ If no - (the discharge of "contaminated" groundwater 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 eco-systems.

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

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:

EPA-approved interim measures consisting of LNAPL thickness measurement and recovery will continue at the six affected SWMUs referenced in the response to Question 2. Interim measures have been performed at these SWMUs since April 1997. The interim measures consist of weekly measurement and recovery at three SWMUs: Main Dock Sump (SWMU 33), Northeast Refinery Area (SWMU 40), and Watery Oil Separator (SWMU 43). Quarterly measurements and/or recovery is performed at the remaining three SWMUs where only a sheen is typically measured. These three SWMUs are the East API Separator (SWMU 3), Barge Dock Sump (SWMU 34), and East Aisle Ditch (SWMU 45). LNAPL thickness and recovery measurements are provided to EPA in RFI Quarterly Progress Reports.

Continued groundwater monitoring at well MDS-4 of the Main Dock Sump (SWMU 33) will be performed until contaminant levels are confirmed to be below groundwater screening levels. The groundwater samples are analyzed for VOCs plus naphthalene. Results are compared to the screening levels discussed in Item 2. Groundwater monitoring is presently performed on a quarterly basis. Results are provided to EPA in RFI Quarterly Progress Reports. In accordance with the existing RCRA Section 3008(h) Corrective Action Order for this facility, groundwater monitoring will continue to be monitored as necessary to protect human health and the environment.

Corrective Measure Studies are proposed for SWMUs with LNAPL present in the subsurface.

References:

1. Anderson, Mulholland & Associates, Inc. (AMAI), March 2005. Final RCRA Facility Investigation Report. Shell Chemical Yabucoa, Inc., Yabucoa, Puerto Rico.

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_ YES - 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 **Shell Chemical Yabucoa, Inc.** facility, EPA ID# PRD090074071 located in Yabucoa, 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 when the Agency becomes aware of significant changes at the facility.

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

   _____ IN - More information is needed to make a determination.

Completed by _____ Date _____
Shell Chemical Yabucoa, Inc.

Reviewed and
Revised by _____ Date _____
Michele Benchouk, Environmental Consultant
Booz Allen Hamilton (for EPA Region 2)

Reviewed by _____ Date _____
Ernst Jabouin, Project Manager
RCRA Programs Branch
EPA Region 2

_____ Date _____
Dale J. Carpenter, Section Chief
RCRA Programs Branch
EPA Region 2

Approved by Original signed by: Date: September 28, 2005
Adolph Everett, Chief
RCRA Programs Branch
EPA Region 2

Locations where References may be found:
U.S. Environmental Protection Agency - Region 2
RCRA File Room
290 Broadway - 15th Floor
New York, New York 10007

Contact telephone and e-mail numbers:
Ernst Jabouin, Project Manager
U.S. Environmental Protection Agency - Region 2
RCRA Program Branch
Telephone: (212) 637-4104
E-mail: Jabouin.Ernst@epa.gov

Attachments

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

Attachment 1 – Summary and Description of the SWMUs Subject to the RFI
Attachment 2 – List of SWMUs at the Facility Not Subject to the RFI
Attachment 3 – Locations of SWMUs
Attachment 4 – Groundwater Monitoring Locations at the Refinery Area (Figure 1)
Attachment 5 – Groundwater Monitoring Locations at the Tank Farm and Dock Area (Figure 2)

North

LEGEND

- Monitoring well sampled during RFI (no exceedances of screening levels)
- Monitoring well sampled during RFI (concentrations equal to or exceeding screening levels, see notes)
- Direct-push groundwater sampling location for RFI
- Monitoring well sampled during other investigations
- Monitoring well with LNAPL greater than sheen (December 2004)
- Surface water and sediment sampling location
- 12 Groundwater elevation - ft above mean sea level (April 2003)
- Groundwater flow direction

NOTES

Well Number	Groundwater Contaminant	Screening Level (ug/L)	Concentration (ug/L)
40-21	2-Methylnaphthalene	24	36.9
AB-1	Arsenic	10	12.3 J

300 0 300 600
Scale feet

Scale	Date
1" = 180'	Sep 2005

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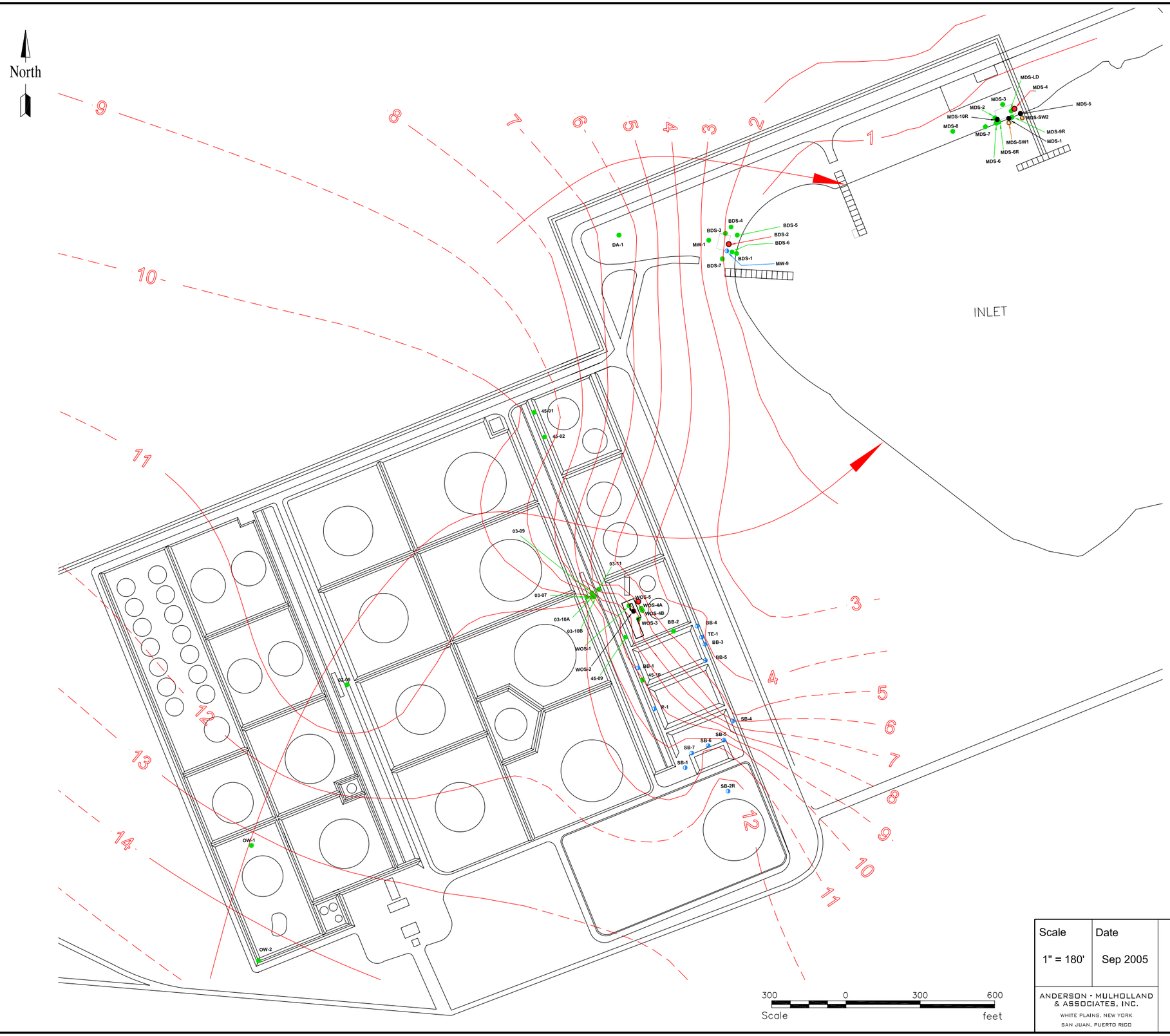
WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 1

Groundwater Monitoring Locations at Refinery Area

Shell Chemical Yabucoa, Inc.
Yabucoa, Puerto Rico



LEGEND

- Monitoring well sampled during RFI (no exceedances of screening levels)
- Monitoring well sampled during RFI (concentrations equal to or exceeding screening levels, see notes)
- Direct-push groundwater sampling location for RFI
- Monitoring well sampled during other investigations
- Monitoring well with LNAPL greater than sheen (December 2004)
- Surface water sampling location
- 12 Groundwater elevation - ft above mean sea level (April 2003)
- Groundwater flow direction

NOTES

Well Number	Groundwater Contaminant	Screening Level (ug/L)	Concentration (ug/L)
MDS-4	Benzene	5	5.1
MDS-4	Naphthalene	6.5	26.4
MDS-4	2-Methylnaphthalene	24	60.1
BDS-2	Arsenic	10	34
WOS-5	Arsenic	10	10

Scale	Date
1" = 180'	Sep 2005

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WHITE PLAINS, NEW YORK
SAN JUAN, PUERTO RICO

Figure 2

Groundwater Monitoring Locations at Tank Farm and Dock Area

Shell Chemical Yabucoa, Inc.
Yabucoa, Puerto Rico