DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

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

Facility Name: **ExxonMobil Bayway Refinery**
Facility Address: **1400 Park Avenue, Linden, New Jersey**
Facility EPA ID #: **NJD062037031**

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

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

Definition of "Migration of Contaminated Groundwater Under Control" EI

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

Relationship of EI to Final Remedies

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

Duration / Applicability of EI Determinations

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

Facility Information

The Bayway Refinery is an active, 1,300-acre industrial facility located in a heavily industrial area within the cities of Linden and Elizabeth, Union County, New Jersey (Figure 1). The facility has been in continuous operation since 1909. Exxon Mobil Corporation (ExxonMobil) owned and operated the refinery from 1909 until its sale to Tosco Refining Company in 1993. Phillips Petroleum Company bought Tosco Corporation in early 2001, and in 2002 merged with Conoco, Inc. to form ConocoPhillips Company. Currently owned and operated by ConocoPhillips, Bayway Refinery is the northernmost U.S. refinery on the eastern seaboard and, according to ConocoPhillips, features the largest fluid catalytic cracking unit in the world. The refinery receives crude oil via tanker primarily from fields in the Atlantic Basin. The facility distributes refined products to customers on the U.S. East Coast via barge, pipeline, truck and railcar. A 775 million-pound-per-year polypropylene plant became operational in the second quarter of 2003.

The facility is located in a low-lying area on New York Harbor adjacent to the Arthur Kill, with ground elevations generally less than 10 feet above mean sea level. Much of the area has been filled to current grade since the beginning of refinery operations in the early 1900s. The main refinery area is bounded to the north by U.S. Route 1, Interstate 278, and Park Avenue, to the west by two cemeteries and U.S. Route 1, and to the south by Wood Avenue (Figure 2). The New Jersey Turnpike passes through the site, separating the main refinery and process area from the waterfront area, which borders on the Arthur Kill. Two outlying tank fields (Rahway River Tankfield and 40-Acre Tankfield) are located southwest of the main refinery area. Morses Creek bisects the site along a southwest to northeast flow track, and has been classified by the State of New Jersey as an FW2-NT/SE3 surface water body. From No. 2 Dam to No. 1 Dam, Morses Creek measures approximately 7,500 feet in length, with an average width of approximately 150 feet. The creek discharges to the Arthur Kill below No. 1 Dam. Ground water at the facility is not used as a drinking water source, and some areas are saline due to naturally-occurring salt water. Pending final signatures and recording, ConocoPhillips has agreed to, and the New Jersey Department of Environmental Protection (NJDEP) has approved, a deed notice that will restrict the refinery property to only non-residential uses. Additionally, the refinery sales agreement between ExxonMobil and Tosco Refining Company limits the property to non-residential uses.

The facility consists of a main petroleum refining facility, a petrochemical manufacturing facility, several tankfields, a fuel distribution terminal, process areas, offices, chemical plants, mechanical shops, wastewater treatment units, tankfields, pipelines, railroad sidings, and tanker docks. Refinery products include motor gasoline, home heating oil, heavy fuel oil, jet fuel, diesel fuel, asphalt, and chemical feedstocks. Products associated with the West Side Chemical Plant include additives for motor oil and high purity propylene. Products associated with the former East Side Chemical Plant included lighter hydrocarbons for product alcohols, ketones, white oils, and other chemicals produced until 1988. The West Side Chemical Plant is currently owned and operated by Infineum USA LP.

The facility operates 24-hours a day, 365-days a year. The refinery maintains a comprehensive site security system that includes perimeter fencing with warning signs, controlled gate access and 24-hour security. The refinery also has a security policy establishing locations and procedures for admittance to the site, including maritime security. Employees and contractors are health and safety trained.

Site investigation and remediation activities have been and are being conducted pursuant to the Administrative Consent Order (ACO) entered into by ExxonMobil (EM) and the NJDEP on November 27, 1991, and amended April 8, 1993, and in accordance with the "Technical Requirements for Site Remediation" (N.J.A.C. 7:26E, et seq). These activities include: the remedial investigation (RI); Interim Remedial Measures (IRMs); Construction Maintenance Emergency Repair Protocol (CMERP), and remedial action.

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

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

   _____ If no - re-evaluate existing data, or

   _____ If data are not available, skip to #8 and enter "IN" (more information needed) status code.

RATIONALE:

Remedial Investigation

In accordance with the Administrative Consent Order (ACO), ExxonMobil conducted a remedial investigation (RI) at the Bayway Refinery to characterize soil, ground water, surface water and sediment. The purpose of the RI is to delineate contamination exceeding applicable criteria. The RI is also performed to characterize the subsurface conditions (geologic and hydrogeologic) at the site.

To best accomplish the goals of the ACO, the RI was conducted in a phased manner. The Site History Report (Geraghty & Miller, 1993) is a compilation of the relevant history of the Site, including operations, spills and disposal history. The Phase 1A portion of the RI was completed in 1995, and the results are contained within the Phase 1A Remedial Investigation Interim Report (Geraghty & Miller, 1995). The Phase 1B portion of the RI was completed between 1996 and 2000, and was summarized in the Phase 1B Remedial Investigation Report (Arthur D. Little, 2000a). The majority of the RI was completed during Phase 1A and Phase 1B. The Phase 2 RI was more limited in scope, focusing on addressing final data gaps.

During the Phase 1A and 1B portions of the RI, the refinery was divided into Investigative Units (A through H) based on hydrogeologic conditions and site use (Figure 3). Each Investigative Unit was further subdivided into Investigative Areas of Concern (IAOCs) based on operations and historical usage (Figure 4). Fifty-one (51) IAOCs have been identified at the Site (Table 1).

ExxonMobil received NJDEP comments on the Phase 1B RI Report for each Investigative Unit in letters from May 2001 through June 2002 (NJDEP 2001a – f, 2002a). The NJDEP letters identified data gaps that needed to be addressed in the Phase 2RI. The Phase 2 RI was performed in accordance with the procedures outlined in the Phase 2 RI Work Plans for individual Investigative Units submitted to the NJDEP during the period from August 2001 to October 2002 (DRAI, 2001 b-e; 2002a, b, d), and the NJDEP comments on the Work Plans (NJDEP, 2002c). The Phase 2 Remedial Investigation Report, which completed the delineation of contamination at the facility, was submitted in April 2004 (TRC Raviv, 2004b).

The data from all phases of the RI, as well as additional investigations, has been loaded into a database. Most of the figures and tables discussed below were drawn directly from this database and include the data from the Phase 1A, Phase 1B, and Phase 2 RIs, as well as additional sampling. A summary of the Sample Designation System is included as Attachment 1.

Interim Remedial Measures

Interim Remedial Measure (IRM) activities, consisting of recovering free product and/or ground water from wells and sumps, are currently conducted at seven (7) areas within the refinery: Domestic Trade Truck Terminal; Caustic Tank No. 3; Spheroid No. 196; Cogen North Leasehold/Fuel Gas; No. 2 Dam Interceptor Trench; Tank No. 519; and the Waterfront Barge Pier. The purpose of the IRM program is to prevent off-site migration and impact to surface water (Figure 5). Over the years, the IRM activities have substantially diminished the free product thicknesses in monitoring wells. IRM activities are conducted on a regular schedule, and reported to the NJDEP on a quarterly basis (TRC Raviv, 2004d).

Remedial Action

Conceptual Remedial Strategies for various waste management areas, free product, soil, and ground water were presented to the NJDEP in October 2000 at the completion of the Phase 1B remedial investigation (Arthur D. Little, 2000b).

The NJDEP comment letter on the Phase 1B RI Report for Unit A also required ExxonMobil to submit proposals for remedial action for certain areas within Unit A that were identified by NJDEP as a potential source of contamination, or as an area where free product or dissolved contamination may be flowing towards potential environmental receptors. The requirements for remedial action at these areas are being addressed through the submission of separate documents including six Remedial Action Selection Reports (RASRs), and the subsequent submission of Remedial Action Work Plans (RAWPs). RASRs were prepared for the following areas (Figure 6): East Side Chemical Plant (ESCP); the Domestic Trade Terminal Area; the Gasoline Blending Tankfield; the Gasoline Component Tankfield; the Pitch Area; and the Caverns Area (DRAI 2002c, 2002e, 2002f, and TRC Raviv 2003c, 2003d, 2004a).

The NJDEP approved the RASRs for the Domestic Trade Terminal Area, the Gasoline Blending Tankfield, the Gasoline Component Tankfield and the Caverns Area (NJDEP 2003a, 2003b, 2003c and 2004). The RAWP for the Domestic Trade Terminal was submitted to NJDEP in June 2004 (TRC Raviv 2004c). The RAWP for Gasoline Blending Tankfield was submitted to NJDEP in December 2004 (TRC Raviv 2004f). The RAWP for the Gasoline Component Tankfield was submitted to NJDEP in February 2005, and the RAWP for the Caverns Area was submitted to NJDEP in March 2005 (TRC Raviv, 2005a and 2005b).

The NJDEP also conditionally approved the RASRs for the Pitch Area and the East Side Chemical Plant in February 2005 (NJDEP 2005a and NJDEP 2005b), and RAWPs are currently being prepared for these IAOCs.

Remedial action activities have been completed at the following areas (Figure 6): Greater Elizabeth Tankfield (TRC Raviv, 2003a) and the Sludge Lagoon Operable Unit (SLOU) (Shaw, 2003). Monitoring reports for these areas are submitted to the NJDEP on a quarterly basis. Remedial activities are currently being conducted at the Former Tank 510 Area (Figure 6), and monitoring reports are submitted to the NJDEP on a quarterly basis (DRAI, 2004e).

In summary, the site consists of 51 IAOCs which have been investigated by ExxonMobil with NJDEP oversight. Since 1993, over 2,900 groundwater samples have been collected from approximately 224 RI monitoring wells, 350 temporary well points and 35 quarterly sampled ExxonMobil NJPDES monitoring wells. Additionally, over 2200 soil and sediment samples have been analyzed. For EI purposes, all of the IAOCs have been adequately characterized and delineated through environmental investigations conducted under the ACO with NJDEP. There is one area—a Public Service Electric and Gas (PSE&G) right-of-way transecting a portion of the site adjacent to the SLOU, IAOC D5–where contamination off-site is considered to be from ExxonMobil. This area has been investigated under the ACO, ground water contaminaton has been delineated., and engineering controls (i.e., a fenced, gated and locked area) at the PSE&G right-of-way are adequate to be protective of human exposure (DRAI, 2001b and TRC Raviv, 2004b). The investigations of all of the IAOCs have provided sufficient data to characterize and evaluate potential impacts on human exposure and delineate the groundwater contamination. It has been determined that the existing engineering and institutional controls are adequate to control human exposure while final remedies are being developed. Active remediation of higher priority areas has already begun. For example, remedial activity at the most significant IAOC at the site--the SLOU--has been completed in 2003. (It should be noted that a positive determination for human exposure is under control--EI CA725--for the site was made on July 6, 2005.)

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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:

Groundwater

The Bayway Refinery is situated in the Newark Basin physiographic province. Approximately 5 to 10 feet of fill material is present throughout the refinery. The fill material consists of reworked clays and silts, as well as heterogeneous mixtures of gravel and sand, with lesser amounts of cinders, construction debris, and wood. In the eastern portion of the facility, the fill is underlain by meadow mat at approximately 5 feet below ground surface (ft-bgs). Glacial till underlies the site at approximately 5 to 10 ft-bgs. The glacial till acts as a confining layer. The bedrock formation beneath the site consists of sedimentary and igneous rocks of the Newark Basin Supergroup. The sedimentary rocks also known as the Passaic Formation consists of reddish-brown thin-bedded shales, siltstones, and sandstones.

According to the City of Linden Health Department, there are no current or planned uses of the ground water in the Bayway Refinery area. All residents of Linden and Elizabeth, NJ are on a municipal water supply system (TRC Raviv, 2003b).

Groundwater in the western portion of the refinery has been designated as Class II-A (potable), which is the New Jersey Department of Environmental Protection's (NJDEP) default designation. However, naturally-occurring inorganic chemicals such as iron, sodium, manganese and aluminum are found throughout the refinery at levels that exceed NJDEP Class II-A Ground Water Quality Standards (GWQS) (N.J.A.C. 7:9-6). Therefore, the groundwater at the refinery is likely not potable even if not contaminated.

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

As discussed in the "Verification of Class III-B Groundwaters" report (DRAI, 2000), ground water in the eastern portion of the refinery has characteristics typical of the NJDEP Class III-B (non-potable) designation – brackish with naturally occurring iron, sodium, manganese, and aluminum concentrations in excess of Class II-A ground water quality standards (GWQS). In the "Proposed Alternative, Site-Specific Ground Water Quality Criteria for the Class III-B Area" report (DRAI, 2001a), ExxonMobil proposed site-specific GWQS for ground waters with the Class III-B designation. The NJDEP conditionally approved the Class III-B reclassification and site-specific Class III-B GWQS in December 2002 (NJDEP 2002b).

Ground water quality results are discussed in the context of the appropriate designation, either Class II-A or Class III-B.

Shallow ground water at the facility flows toward surface water bodies (Figure 5). At the most southern parts of the facility, shallow ground water flow towards the Rahway River and in the northern parts, ground water flow towards Morses Creek and the Arthur Kill. Secondary features in the bedrock, such as partings, fractures, and joints, influence ground water flow in the Passaic Formation. In refinery areas, bedrock is generally covered by low-permeability glacial till or alluvium; a confined condition generally exists at shallow depths.

Ground water investigations have been conducted at the Bayway Refinery as part of the RI and IRM programs discussed in response to Question 1, above. Since 1993, over 1,000 ground water samples have been collected from approximately 224 monitoring wells and approximately 350 temporary well points.

To determine if ground water is known or reasonably suspected to be "contaminated" at or from the facility, ground water data were evaluated to identify exceedances of applicable criteria: for Class II-A groundwater, the NJDEP GWQC (N.J.A.C. 7:9-6, et seq.); and for Class III-B groundwater, the alternate, site-specific Class III-B GWQC that were conditionally approved by NJDEP (DRAI, 2001 and NJDEP, 2002). A listing of the NJDEP Class II-A GWQC and the alternate, site-specific Class III-B GWQC is included in Table 2.

Contaminants of Concern (COCs) were identified in the Phase 1B RI Report for specific areas of the refinery as the primary contaminants that exceeded applicable criteria in that area (Arthur D. Little, 2000a). Contaminants that were low level, isolated occurrences, or if the exceedances appeared spurious, were not designated as COCs. The COCs identified in the Class II-A and Class III-B ground water areas are provided in Table 3.

Locations of Contamination (LOCs) were then identified, which include locations where there were exceedances of Class II-A or the alternate, site-specific Class III-B GWQC. Groundwater LOCs include areas of contiguous exceedances in ground water of chemicals that are related to historic or current operations in the IAOC. Locations where exceedances have been detected, but are isolated, low-level, or not IOAC-related, are not included in LOCs. Groundwater LOCs, which define the horizontal limits of existing ground water contamination at the facility, are shown on Figure 5.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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 migration of contaminated ground water can be reasonably considered to be stabilized, such that existing plumes are not continuing to expand above levels of concern. The following discussion presents the rationale and physical evidence (e.g., ground water sampling data) for this conclusion.

Delineation of Ground Water Contamination

The purpose of the RI being conducted at the Bayway Refinery (see Question 1 for more information) is to delineate contamination exceeding applicable criteria. The RI is also performed to characterize the subsurface conditions (geologic and hydrogeologic) at the site. The majority of the RI at the Bayway Refinery was completed during Phase 1A and Phase 1B. The Phase 2 RI was more limited in scope, focusing on addressing final data gaps.

Existing areas of ground water contamination were identified during the Phase 1B RI (Arthur D. Little, 2000a). As discussed in response to Question 2, Groundwater LOCs, which include areas of contiguous exceedances of Class II-A GWQC or the alternate, site-specific Class III-B GWQC of chemicals that are related to historic or current operations in the IAOC, are shown in Figure 5.

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[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.

Groundwater LOCs define the horizontal limits of existing ground water contamination at the facility. Glacial till underlies the site at approximately 5 to 10 ft-bgs. The glacial till acts as a confining layer, and generally defines the vertical limits of existing ground water contamination at the facility. Ground water sampling data results from the Phase 2 RI indicate that the dimensions of the existing areas of ground water contamination (LOCs) remain essentially unchanged. Therefore, the migration of contaminated groundwater has stabilized, and is expected to remain within the existing areas of contaminated groundwater.

Interim Remedial Measures

Interim Remedial Measure (IRM) activities, consisting of recovering free product and/or ground water from wells and sumps, are currently conducted with NJDEP oversight at seven (7) areas within the refinery: Domestic Trade Truck Terminal; Caustic Tank No. 3; Spheroid No. 196; Cogen North Leasehold/Fuel Gas; No. 2 Dam Interceptor Trench; Tank No. 519; and the Waterfront Barge Pier (Figure 6). These areas are discussed below.

The purpose of the IRM program is to prevent off-site migration and impact to surface water. Over the years, the IRM activities have substantially diminished the free product thicknesses in monitoring wells. IRM activities are conducted on a regular schedule, and reported to the NJDEP on a quarterly basis (TRC Raviv, 2004d).

Domestic Trade Terminal

Transportation fuels are present at the Domestic Trade Terminal in close proximity to the reservoirs. The IRM activities at the Domestic Trade Terminal consist of removing free product from wells and sumps using a vacuum truck. IRM activities have substantially diminished the free product thicknesses in monitoring wells.

The proposed remedial action for this area consists of a Biowall system, which includes sheet piling, a recovery trench, in-situ biological reactor, and dispersion zone. A Remedial Action Selection Report (RASR) for the Domestic Trade Terminal was submitted to the NJDEP in September 2002 (DRAI, 2002a) and conditionally approved by NJDEP in June 2003 (NJDEP, 2003a). A Remedial Action Workplan (RAWP) was submitted to the NJDEP in June 2004 (TRC Raviv, 2004c).

Caustic Tank No. 3

An IRM is currently in place in this area as a result of historic spills, which resulted in high pH in the ground water. The IRM activities consist of pumping wells with high pH using a vacuum truck. The impacted ground water at the Caustic Tank No. 3 area has been delineated and surface water bodies are not present in this area.

Spheroid No. 196

The Spheroid No. 196 area is located within the Gasoline Blending Tankfield, adjacent to Morses Creek. The IRM activities at the Spheroid No. 196 consist of removing free product from wells using a vacuum truck. IRM activities have substantially diminished the free product thicknesses in monitoring wells.

The proposed remedial action for this area consists of a containment wall system, which includes sheet piling, a recovery trench and wells, and treatment of the groundwater in the refinery waste water treatment system. The RASR for the Gasoline Blending Tankfield was submitted to the NJDEP in November 2002 (DRAI, 2002c) and conditionally approved by the NJDEP in June 2003 (NJDEP, 2003b). The RAWP was submitted to the NJDEP in December 2004 (TRC Raviv, 2004f).

Cogen North Leasehold/Fuel Gas
The IRM activities at the Cogen North Leasehold/Fuel Gas area consist of removing free product from wells using a vacuum truck. IRM activities have substantially diminished the free product thicknesses in monitoring wells.

The remedial action for the observed free product and impacted ground water in this area was addressed in the revised RASR prepared for the adjacent East Side Chemical Plant (ESCP) (TRC Raviv, 2003d), and includes containment and treatment. Upgradient of the Class III-B area, the remedial action for the ground water will consist of monitored natural attenuation (MNA).

No. 2 Dam Interceptor Trench
Sheet piling and a ground water recovery trench have been installed along and adjacent to Morses Creek to prevent off-site migration of ground water with sulfuric acid odors. The current IRM activities at this area consist of recovering ground water from the trench; the pumped water is treated at the refinery wastewater treatment plant.

Tank No. 519
IRM activities are currently in place in this area to prevent off-site migration of free product and discharge to surface water. Recovery operations are being conducted using pulsed vacuum recovery system from trenches and monitoring wells.

Waterfront Barge Pier
The Waterfront Barge Pier is located in the proximity to the Arthur Kill. The current IRM activities at this area consist of removing free product and impacted ground water from recovery trenches using a pump and treat system augmented with a vacuum truck. The pumped water is treated at the refinery wastewater treatment system. IRM activities (pumping) have reversed ground water flow away from the Arthur Kill and have controlled the migration of free product, with no petroleum sheens observed on the surface water.

Additional Remedial Action

The purpose of the IRM program is to prevent off-site migration and impact to surface water. More permanent remedial measures are being addressed with NJDEP oversight, as outlined below.

Conceptual Remedial Strategies for various waste management areas, free product, soil, and ground water were presented to the NJDEP in October 2000 at the completion of the Phase 1B remedial investigation (Arthur D. Little, 2000b).

The NJDEP comment letter on the Phase 1B RI Report for Unit A also required ExxonMobil to submit proposals for remedial action for certain areas within Unit A that were identified by NJDEP as a potential source of contamination, or as an area where free product or dissolved contamination may be flowing towards potential environmental receptors. The requirements for remedial action at these areas are being addressed through the submission of separate documents including six RASRs, and the subsequent submission of RAWPs. RASRs were prepared for the following six areas (Figure 7): East Side Chemical Plant (ESCP); the Domestic Trade Terminal Area; the Gasoline Blending Tankfield; the Gasoline Component Tankfield; the Pitch Area; and the Caverns Area (DRAI 2002c, 2002e, 2002f and TRC Raviv 2003c, 2003d, 2004a).

The NJDEP approved the RASRs for the Domestic Trade Terminal Area, the Gasoline Blending Tankfield, the Gasoline Component Tankfield and the Caverns Area (NJDEP 2003a, 2003b, 2003c and 2004). The RAWP for the Domestic Trade Terminal was submitted to NJDEP in June 2004 (TRC Raviv 2004c) and the RAWP for Gasoline Blending Tankfield was submitted to NJDEP in December 2004 (TRC Raviv 2004f). The RAWP for the Gasoline Component Tankfield was submitted to NJDEP in February 2005, and the RAWP for the Caverns Area was submitted to NJDEP in March 2005 (TRC Raviv, 2005a and 2005b). The NJDEP conditionally approved the RASRs for the Pitch Area and the East Side Chemical Plant in February 2005 (NJDEP 2005a and 2005b). RAWPs are currently being prepared for these IAOCs.

IRM Areas

Long-term remedial action plans for three IRM areas: Domestic Trade Terminal; Spheroid No. 196 Area (addressed as part of the Gasoline Blending Tankfield RASR); and the Cogen North Leasehold/Fuel Gas Area (addressed as part of the ESCP RASR) were discussed above.

Gasoline Component Tankfield

The Gasoline Component Tankfield is located within Unit A. A RASR was submitted to the NJDEP in October 2002 (DRAI, 2002e) and conditionally approved by the NJDEP in June 2003 (NJDEP, 2003c). The RAWP was submitted to NJDEP in February 2005 (TRC Raviv 2005a).

The proposed remedial action consists of a Biowall system, which includes sheet piling, a recovery trench, biowall reactor, and dispersion zone. Free product removal using vacuum trucks or a similar alternative was proposed in areas distant to surface water bodies. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Pitch Area

The Pitch Area is located within the Class III-B area in Unit A. A revised RASR for the Pitch Area that addresses containment of groundwater contamination was submitted to the NJDEP in February 2004 (TRC Raviv 2004a) and conditionally approved by the NJDEP in February 2005 (NJDEP 2005a). The RAWP is currently being developed. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Caverns Area

The Caverns Area is located within Unit A. Portions of the Caverns Area ground water have a Class II-A designation, and portions have a Class III-B designation. A revised RASR for the Caverns Area was submitted to the NJDEP in October 2003 (TRC Raviv, 2003c) and conditionally approved by the NJDEP in July 2004 (NJDEP 2004). The RAWP was submitted to NJDEP in March 2005 (TRC Raviv 2005b).

The proposed remedial action consists of a barrier wall and recovery wells or trench along the west side of the Poly Ditch. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

On-going/Completed Remedial Activities

Groundwater remediation has also been completed or is ongoing at other areas within the refinery, as outlined below.

Remedial action activities have been completed at the following areas (Figure 7): Greater Elizabeth Tankfield (TRC Raviv, 2003a) and the Sludge Lagoon Operable Unit (SLOU) (Shaw, 2003). Monitoring reports for the SLOU are submitted to the NJDEP on a quarterly basis.

Remedial activities are currently being conducted at the Former Tank 510 Area (Figure 7). A Biowall system consisting of a sheet piling, a recovery trench, in-situ biological reactor and dispersion area was installed in the proximity to the reservoir in 2000 to prevent off-site migration of free product and impacted ground water.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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:

Ground water with detected concentrations of contaminants is located within approximately 200 feet of surface water at various locations within the Bayway Refinery, as outlined below.

Groundwater Flow

As discussed in response to question 2, approximately 5 to 10 feet of fill material is present throughout the refinery. The fill material consists primarily of reworked clays and silts, as well as heterogeneous mixtures of gravel and sand, with lesser amounts of cinders, construction debris, and wood. Shallow ground water is present within this fill material, and flows towards surface water bodies (Figure 5). At the most southern parts of the facility, shallow ground water flows toward the Rahway River and in the northern parts, ground water flows toward Morses Creek and the Arthur Kill.

In the eastern portion of the facility, the fill is underlain by meadow mat at approximately 5 feet below ground surface (ft-bgs). Glacial till underlies the site at approximately 5 to 10 ft-bgs. The glacial till acts as a confining layer. The bedrock formation beneath the site consists of sedimentary and igneous rocks of the Newark Basin Supergroup. The sedimentary rocks also known as the Passaic Formation consists of reddish-brown thin-bedded shales, siltstones, and sandstones. Secondary bedrock features such as partings, fractures, and joints influence ground water flow in the Passaic Formation. At the refinery, bedrock generally is covered by low-permeability glacial till or alluvium, and a confined condition generally exists at shallow depths.

In general, shallow groundwater at the facility flows towards surface water bodies. At the southern parts of the facility (e.g., Units F and G), shallow groundwater flows towards the Rahway River and in the northern parts, ground water flow towards Morses Creek and the Arthur Kill. (Morses Creek traverses the site from west boundary and flows easterly into Arthur Kill.) In the shallow aquifer, sewers and local fill material have secondary influences on the groundwater flow. In the bedrock aquifer, secondary features, such as partings, fractures, and joints influence ground water flow in the Passaic Formation. In refinery areas, bedrock is generally covered by low-permeability glacial till or alluvium; a confined condition generally exists at shallow depths.

Groundwater investigations have been conducted at the Bayway Refinery as part of the RI and IRM programs discussed in response to Question 1, above. Since 1993, over 1,000 ground water samples have been collected from approximately 244 monitoring wells and approximately 350 temporary well points. Contaminants of Concern (COCs) identified in ground water during the RI are listed in Table 2. (Refer to Attachment 1 for maps and tables showing all exceedances of applicable NJDEP's GWQC-- either Class II-A or Class III-B--in groundwater.)

Consistent with the historic use of the facility, the dissolved phase groundwater contamination plumes (consisting primarily of benzene) have been identified and delineated at the facility. Vertically, the plumes primarily exist within the shallow water bearing zone. The groundwater plumes are in the northern and interior portions of the site and migrate towards Morses Creek and Arthur Kill. There is no groundwater contamination that is expected to migrate to the Rahway River. Other than the previously discussed Public Service Property, the groundwater plumes do not extend off-site.

Free Product

Free product seeps have historically been observed to discharge to surface water from the Domestic Trade Terminal, Spheroid No. 196 area, Tank No. 519 area, and the Waterfront Barge Pier. Sorbent boom has been installed along the shoreline in these areas to contain and prevent further any downgradient migration of petroleum sheens. As discussed in response to question 3, Interim Remedial Measures (IRMs) have been in place at these and three other areas to prevent off-site migration and impacts to surface water from free product (and/or impacted ground water) since at least the early 1990s. Over the years, the IRM activities have substantially diminished the free product thicknesses in monitoring wells.

A hydrocarbon seep was also observed at the Poly Ditch, located within the Caverns Area. Sorbent boom has been installed along the shoreline, and a remedial action was proposed in October 2003 to NJDEP as part of the Revised Caverns Area RASR to prevent any further discharge to surface water in this area (TRC Raviv, 2003c). The NJDEP conditionally approved the revised RASR in July 2004 (NJDEP, 2004). The RAWP is currently being developed. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Dissolved-Phase Contamination

As discussed in response to question 3, ground water sampling data results from the Phase 2 RI indicate that the dimensions of the existing areas of ground water contamination (or LOCs – Locations of Contamination) remain essentially unchanged (Figure 5). Therefore, it is reasonable to consider that the migration of contaminated groundwater has stabilized, and is expected to remain within the existing areas of contaminated groundwater.

In order to determine if contaminated groundwater has the potential to discharge into surface water, all ground water samples (including monitoring wells and temporary well points) within approximately 200-feet of surface water were identified. The maximum concentration of key

contaminants from these sample locations was then compared to its appropriate NJDEP ground water quality criteria, either Class II-A or Class III-B. Based on these results, ground water samples located within approximately 200-feet of surface water that exceeded applicable NJDEP and site-specific ground water quality criteria in Investigative Units A, B, C, D, E and G are listed in Table 4 and illustrated on Figure 5.

Potentially Affected Surface Water Bodies

Surface water bodies are present both within and adjacent to the Bayway Refinery (Figure 5). Morses Creek runs through the site and flows from the west border of the site to the east towards the Arthur Kill. Piles Creek is located at the southeast part of the site, adjacent to the Sludge Lagoon Operable Unit and also discharges to the Arthur Kill.

Ground water samples that exceeded NJDEP and site-specific ground water quality criteria are located within approximately 200-feet of the following surface water bodies: the Arthur Kill; Morses Creek (including the Peach Orchard Creek and West Brook Reservoirs, the Tremley Tankfield Outfall Ditch, the Poly Ditch, Condensor Ditch, ESEN Basin and an unnamed tributary to Morses Creek); and Piles Creek (Figure 5). Although Piles Creek could potentially be impacted, groundwater data indicates that the plume in proximity to Piles Creek can be reasonably considered stable and does not extend to Piles Creek. (Archibald, Brent, 2005).

The two main surface water bodies at the site are Morses Creek (which runs through the site and discharges to the adjacent Arthur Kill) and Piles Creek. These surface water bodies are not used as actual or potential drinking water sources. Additionally, they are not used for recreational purposes. Surface water use at and adjacent to the site is for commercial ship transportation and refinery process water intakes. At the site, Morses Creek has several dams located and operated by the Refinery. It should be noted that these dams, along with fences and 24-hour seven days a week security patrols, prevent any unauthorized access to Morses Creek at the Refinery. Refinery permits are required to enter Morses Creek. Entrance is only allowed for Refinery purposes or environmental sampling. As part of the Refinery permit process strict health and safety requirements must be followed to ensure worker protection from exposure to potential contaminants as well as general water safety. Similar requirements also exist for those portions of the Arthur Kill adjacent to the Refinery. Only approved commercial vessels may enter the docks or shoreline. Only trained personnel, wearing appropriate protective equipment may enter the shore adjacent to the Refinery. All vessels are subject to the Refinery permit procedures. Both Refinery security personnel and the US Coast Guard patrol the dock and adjacent shoreline.

Additionally, there are a series of booms located along the Refinery dock area at the Arthur Kill. These are for contingency purposes in case of a spill during vessel loading and unloading activities.

As a conservative scenario, even if the groundwater plume has migrated into the surface water (specifically Morses Creek, which has the two dam systems), sampling required (under a NJPDES permit) would effectively limit the contamination discharging into the Arthur Kill. It

should be noted that normally, due to the amount of water usage, it is necessary to pump additional water from the Arthur Kill to supplement the Morses Creek water usage.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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

____ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional 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. **(See discussion above).**

_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:

As discussed in response to question 4, ground water samples located within approximately 200-feet of surface water in Investigative Units A, B, C, D, E and G contain contaminant concentrations greater than the applicable NJDEP ground water quality criteria (either Class II-A or site-specific Class III-B).

The following discussion is aimed at determining if the potential discharge of contaminated

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

groundwater into surface water is likely to be "insignificant" (i.e., the maximum concentration of key contaminants discharging into surface water is less than 10 times their appropriate groundwater level).

Please refer to Question 6 for a discussion which shows the discharge of contaminated ground water into surface water is currently acceptable, and will not cause impacts to surface water, sediments or eco-systems.

As discussed in response to question 1, for the RI, the refinery was divided into Investigative Units (Units A through H) based both on hydrogeologic conditions and site usage (Figure 3). Each Investigative Unit was further subdivided into IAOCs based on operations and historical usage (Figure 4). Fifty-one (51) IAOCs have been identified at the Site (Table 1).

Twenty-one (21) of the 51 IAOCs are located within approximately 200-feet of surface water, and contain ground water samples with contaminant concentrations greater than the applicable NJDEP ground water quality criteria (either Class II-A or site-specific Class III-B) or free product. The following discussion includes only these 21 AOC's and is grouped by IAOC within each Investigative Unit.

Investigative Unit A

Unit A contains both Class II-A and Class III-B designated ground water areas (Figure 5). Therefore, each IAOC is discussed below in terms of its appropriate ground water classification – either Class II-A and/or Class III-B.

East Side Chemical Plant (IAOC A7a)

The Class III-B designated ground water area is located within the East Side Chemical Plant (ESCP) (Figure 5). Therefore, the ground water areas are discussed below in terms of their appropriate ground water classification – either Class II-A or Class III-B.

Class II-A Ground Water

One ground water sample (ASB-166) is within 200-feet of the Condenser Ditch in the ESCP. The sample contains contaminant concentrations of benzene) 100 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5).

Two ground water samples (ASB-181 and GMW-203) are within 200 feet of the ESEN Basin in the ESCP, and contain contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5). These samples also contain contaminant concentrations of acetone and isophorone 100 times greater than the criteria. This sample location (ASB-181/GMW-203) is located immediately upgradient of the Class III-B area. Therefore, concentrations will meet the Class III-B criteria before discharging to surface water.

Class III-B Ground Water

No ground water samples within 200-feet of the ESEN Basin in the ESCP contain contaminant concentrations exceeding NJDEP Class III-B GWQC.

The proposed remedial action for the ESCP area consists of a combination of monitored natural attenuation (MNA) and ground water collection (for treatment at refinery waste water treatment plant). A Remedial Action Selection Report (RASR) for the East Side Chemical Plant was submitted to the NJDEP in December 2003 (TRC Raviv, 2003e) and approved by the NJDEP in February 2005 (NJDEP, 2005b). The RAWP is currently being developed.

Gasoline Blending Tankfield (IAOC A8)
Nine ground water samples are within 200-feet of Morses Creek in the Gasoline Blending Tankfield. Three samples (SBMW-1, MC-1 and GMW-205) contain contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5). Six samples (GMW-71, SMW-6, ASB-361, GMW-70, ASB-367 and ASB-113) contain contaminant concentrations of benzene 100 times greater than criteria. Down gradient of ASB-361 a sample location (SBMW-1) is only 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5). GMW-204is down gradient of ASB-113 and is below the exceedances level. Free product has also been observed in monitoring wells in this area.

As discussed in response to question 3, ExxonMobil has been performing an IRM in the vicinity of Spheroid No. 196 (within the Gasoline Blending Tankfield) since the early 1990s. The IRM includes vacuum truck pumping to remove free product from selected wells.

The remedial action for this area consists of a sheet piling, recovery trenches and wells and treatment of water at the refinery waste water treatment plant. A Remedial Action Selection Report (RASR) for the Gasoline Blending Tankfield was submitted to the NJDEP in November 2002 (DRAI, 2002c) and conditionally approved by NJDEP in June 2003 (NJDEP, 2003a). A Remedial Action Workplan (RAWP) was completed in December 2004 (TRC Raviv, 2004).

Conservation Area /BIOX Unit (IAOC A9)
One ground water sample (GMW-120) is within 200-feet of Peach Orchard Creek Reservoir in the Conservation Area, and contains contaminant concentrations of arsenic 10 times greater than the NJDEP Class II-A GWQC (Table 5). A down gradient sample location (GMW-206) is below exceedances levels for arsenic.

Gasoline Component Tankfield (IAOC A10)
Three ground water samples are within 200-feet of Peach Orchard Creek Reservoir in the Gasoline Component Tankfield. One ground water sample (GMW-2B) contains contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5). Two samples (GMW-79 and GMW-115) contain contaminant concentrations greater than 100 times criteria (e.g., benzene). GMW-208 is a down gradient sample location but no benzene has been detected in this well.

The remedial action for this area consists of a Biowall system, which includes sheet piling, a recovery trench, biowall reactor, and dispersion zone. A Remedial Action Selection Report (RASR) for the Gasoline Component Tankfield was submitted to the NJDEP in October 2002 (DRAI, 2002b) and conditionally approved by NJDEP in June 2003 (NJDEP, 2003a). A Remedial Action Workplan (RAWP) is currently being developed. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Domestic Trade Terminal (IAOC A13)
Three ground water samples (ASB-156, D-S-3 and ASB-157) are within 200-feet of Peach Orchard Creek Reservoir in the Domestic Trade Terminal, and contain contaminant concentrations of benzene 100 times greater than the NJDEP Class II-A GWQC (Table 5). Free product has also been observed in monitoring wells and sumps in this area.

As discussed in response to question 3, ExxonMobil has been performing an IRM at the Domestic Trade Terminal since 1992. The IRM includes vacuum truck pumping to remove free product from selected wells and sumps. IRM activities have substantially diminished the free product thicknesses in monitoring wells, resulting in the stabilization of the free product plume(s).

The remedial action for this area consists of a Biowall system, which includes sheet piling, a recovery trench, biowall reactor, and dispersion zone. A Remedial Action Selection Report (RASR) for the Domestic Trade Terminal was submitted to the NJDEP in September 2002 (DRAI, 2002a) and conditionally approved by NJDEP in June 2003 (NJDEP, 2003a). A Remedial Action Workplan (RAWP) was completed in June 2004 (TRC Raviv, 2004).

Cogeneration Plant (IAOC A16)
One ground water sample (ASB-79) within approximately 200-feet of the Condenser Ditch contains contaminant concentration (e.g., lead) greater than 10 times the NJDEP Class II-A GWQC (Table 5). However, ASB-79 is a temporary point (drive point). The lead exceedance is attributed to suspended sediment associated with non-low flow sampling techniques and sample locations (i.e., temporary drive points which produce silty samples).

Caverns Area (IAOC A17)
The Class III-B designated ground water area is located within the Caverns Area IAOC (Figure 4). Therefore, the ground water areas are discussed below in terms of their appropriate ground water classification – either Class II-A or Class III-B.

Class II-A Ground Water
One ground water sample within 200-feet of the Poly Ditch in the Caverns Area contains contaminant concentrations of benzene10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 6). However, this monitoring well (GMW-73) is located immediately upgradient of the Class III-B area. The concentrations will meet the Class III-B criteria before discharging to surface water.

Class III-B Ground Water
No ground water samples within 200-feet of the Poly Ditch in the Caverns Area contain contaminant concentrations exceeding NJDEP Class II-A GWQC. Free product has also been observed along the Poly Ditch in this area.

A revised RASR for the Caverns Area was submitted to the NJDEP in October 2003 (TRC Raviv, 2003d), and consists of a barrier wall and recovery wells or trench along the west side of the Poly Ditch to prevent discharge of free product and ground water. The RASR was conditionally approved by the NJDEP in July 2004 (NJDEP 2004); the RAWP for the Caverns Area was submitted to NJDEP in March 2005 (TRC Raviv, 2005b). The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Pitch Area (IAOC A18)
The Class III-B designated ground water area is located within the Pitch Area IAOC (Figure 6). Therefore, the ground water areas are discussed below in terms of their appropriate ground water classification – either Class II-A or Class III-B.

Class II-A Ground Water
One ground water sample within 200-feet of Morses Creek in the Pitch Area contains contaminant concentrations (e.g., manganese) greater than 100 times the NJDEP Class II-A GWQC (Figure 6). However, this monitoring well (L-15A) is located immediately upgradient of the Class III-B area; and the manganese concentration is considered naturally occurring. Furthermore, L-15A was not collected using low flow methodology;

therefore metals are attributed to suspended sediment associated with non-low flow sampling techniques.

Class III-B Ground Water

Two ground water samples are within 200-feet of Morses Creek in the Pitch Area. Sample ASB-163 contains concentrations of arsenic 10 times greater than the NJDEP Class II-A GWQC (Table 6 and Figure 5). Sample ASB-161 contains concentrations of arsenic 100 times greater than criteria. However, these samples were collected from temporary wells (drive points) and not using low flow methodology. Therefore metals exceedances are attributed to suspended sediment (i.e., temporary drive points produce silty samples).It should also be noted that a Class III-B GWQC has not been proposed for arsenic at this time; therefore, the Class II-A GWQC for arsenic was used. ASB-161 and ASB-163 are upgradient of GMW-137 and GMW-126, respectively. Both downgradient samples were below 10 times the Class II-A GWQC criteria for arsenic and are between the ASB-161 and ASB-163 samples and any surface water discharge point.

A revised RASR for the Pitch Area was submitted to the NJDEP in February 2004 (TRC Raviv, 2004a) that addressed containment (capping system and barrier wall) of ground water contamination. NJDEP conditionally approved the RASRs in February 2005 (NJDEP 2005a) and the RAWP is currently being prepared for this IAOCs. The remedial action plan, when implemented, will enhance NJPDES permit control already in place that would prevent unacceptable contamination discharging from Morses Creek into the Arthur Kill.

Investigative Unit B

Investigative Unit B lies entirely within the Class III-B designated ground water area (Figure 5). Therefore, the ground water data for this Unit is compared to the site-specific Class III-B GWQC. As directed by the NJDEP, if Class III-B GWQC is not available, Class II-A GWQC is used.

Tank 336 Creek Dredgings Area (IAOC B1)

One ground water sample (GMW-23) is within 200-feet of Morses Creek in the Tank 336 Creek Dredgings Area, and contains contaminant concentrations of arsenic 100 times greater than the NJDEP Class II-A GWQC (Table 6 and Figure 5).

Western Waterfront Tankfield (IAOC B2)

One ground water sample (GMW-21) is within 200-feet of an unnamed tributary of Morses Creek in the Western Waterfront Tankfield, and contains contaminant concentrations of arsenic 100 times greater than the NJDEP Class II-A GWQC (Table 6 and Figure 5). The sample exceedance occurred in January 1994 and was an unfiltered sample. All subsequent filtered samples or low flow samples were below the exceedance level. Therefore, this discharge is not considered significant. It should be noted that a Class III-B GWQC has not been proposed for arsenic at this time; therefore, the Class II-A GWQC was used.

Tank 301 Creek Dredgings (IAOC B3)

One ground water sample (BSB-15) within 200-feet of Morses Creek in the Tank 301 Creek Dredgings Area contains contaminant concentrations of arsenic and 4,4'-DDD 10 times greater than the NJDEP Class II-A GWQC (Table 6 and Figure 5). It should be noted that Class III-B GWQC have not been proposed for arsenic or 4,4'-DDD at this time; therefore, the Class II-A GWQC were used. It should also be noted that BSB-15 is a temporary well (drive point), and this sample was not collected using low flow methodology. Exceedances are attributed to suspended sediment associated with non-low flow sampling (i.e., drive points produce silty samples).

Investigative Unit C

Unit C contains both Class II-A and Class III-B designated ground water areas (Figure 5). Therefore, each IAOC is discussed below in terms of its appropriate ground water classification, either Class II-A or Class III-B.

Fire Fighting Landfill (IAOC C2)
One ground water sample (CSB-61) within 200-feet of an unnamed small creek in the Fire Fighting Landfill contains contaminant concentrations of 4-Methyl-2-pentanone 10 times greater than the NJDEP Class II-A GWQC (Table 6 and Figure 5). It should be noted that a Class III-B GWQC has not been proposed for 4-Methyl-2-pentanone at this time; therefore, the Class II-A GWQC was used. Although CSB-61 is within 200 feet of the small stream the direction of ground water flow is toward the Aurthur Kill (Figure 5). There are two down-gradient sample locations (CSB-60 and GMW-112) that are below the NJDEP Class II-A GWQC for 4-Methyl-2-pentanone. Also the most likely discharge point for is over 400 feet from this sample location.

No ground water samples within approximately 200-feet of the Arthur Kill in the Fire Fighting Landfill IAOC contain contaminant concentrations greater than 10 times the Class III-B GWQC (Table 6 and Figure 5).

Eastern Waterfront Tankfield/Pier (IAOC C3)
No ground water samples within 200-feet of Morses Creek in the Tank 336 Eastern Waterfront Tankfield/Pier area contain contaminant concentrations exceeding NJDEP Class III-B GWQC.

Free product has been observed in monitoring wells and sumps in this area. As discussed in response to question 3, ExxonMobil is currently conducting an IRM at the Eastern Waterfront Tankfield/Barge Pier. The IRM includes vacuum truck pumping to remove free product from selected wells and sumps.

Steamer Dock (IAOC C5)
Portions of this IAOC are within the Class II-A designated area, and portions are within the Class III-B designated area (Figure 4). Therefore, the ground water data for this IAOC are discussed below in terms of their appropriate ground water classification – either Class II-A or Class III-B.

Class II-A Ground Water
One ground water sample (GMW-31) within 200-feet of the Arthur Kill in the Steamer Dock area contains iron concentrations greater than 10 times the NJDEP Class II-A GWQC (Figure 5). However, due to its proximity to the Class III-B area and the Arthur Kill, the iron is considered naturally occurring. Therefore, the discharge of contaminated ground water into surface water from the Class II-A area of the Steamer Dock IAOC is not considered significant.

Class III-B Ground Water
No ground water samples within 200-feet of Morses Creek or the Arthur Kill in the Steamer Dock area contain contaminant concentrations greater than 10 times the Class III-B GWQC (Figure 5).

Investigative Unit D

Investigative Unit D lies entirely within the Class II-A designated ground water area (Figure 4). Therefore, the ground water data for this Unit is compared to the NJDEP Class II-A GWQC.

Tremley Tankfield (IAOC D1)
One ground water sample (DSB-379) within 200-feet of the Tremley Tankfield Outfall Ditch contains contaminant concentrations of benzene10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5). GMW-170 is a down gradient well and no benzene has been detected in the well. One sample (DSB-43) contains manganese concentrations greater than 100 times criteria, but this is considered naturally occurring and not significant. Additionally, DSB-43 is a temporary well (drive point), and this sample was not collected using low flow methodology. Exceedances are attributed to suspended sediment associated with non-low flow sampling techniques.

Current and Former Diesel Tankfield (IAOC D3a)
Two ground water samples (GMW-33 and GMW-33-20) within 200-feet of West Brook Reservoir and/or Morses Creek in the Current and Former Diesel Tankfield contain contaminant concentrations of benzene100 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5). DSB-183 is down gradient of GMW-33 and no benzene has been detected in the well. DSB-176 is down gradient of GMW-33-20 and no benzene has been detected in the well.

As discussed in response to question 3, a Biowall system consisting of sheet piling, a recovery trench, Biowall reactor and dispersion area was installed at the Tank 510 Area in 2000 to prevent off-site migration of free product and impact on ground water.

As discussed in response to question 3, IRM activities are currently in place in this area (Tank No. 519 IRM) to prevent off-site migration of free product and discharge to surface water. Recovery operations are being conducted using pulsed vacuum recovery system.

Tank 519 Creek Dredgings Area (IAOC D4)
Two ground water samples (MW519-12 and MW519-2) within 200-feet of Morses Creek in the Tank 519 Creek Dredgings Area contain contaminant concentrations of manganese (100 times) and iron (10 times) greater than the NJDEP Class II-A GWQC (Figure 5). However, these samples contain detected concentrations of naturally-occurring constituents and being drive points, weren't collected using low flow methodology. Exceedances are associated with suspended sediments. Free product has also historically been observed at these locations.

SLOU Boundary (IAOC D5)
Five ground water samples (DSB-370, DSB-371, DSB-54, DSB367 and DSB-366) within 200-feet of an unnamed surface water body in the SLOU boundary area contain contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 6). Two samples (DSB-372 and DSB-368) contain contaminant concentrations of benzene 100 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 6). One sample GMW-63 contains contaminant concentrations of arsenic 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 6) DSB-369 is down gradient of DSB-372 and is only 10x the exceedances level. DSB-367 is down gradient of DSB-377 and is only 10x the exceedances level. However, DSB-366, DSB-367, DSB-369 DSB-370, DSB-371 and DSB-377 are temporary wells (drive points) and were not collected using low flow methodology. Therefore exceedances are attributed to suspended sediments associated with non-low flow sampling (i.e., drive points produce silty samples).

Western Shore of Reservoir (IAOC D6)
One ground water sample (DSB-49) within 200-feet of West Brook Reservoir in IAOC D6 contains contaminant concentrations of benzene 100 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5).

Investigative Unit E

Unit E contains both Class II-A and Class III-B designated ground water areas (Figure 4). Therefore, each IAOC is discussed below in terms of its appropriate ground water classification – either Class II-A and/or Class III-B.

Clean Fill Area (IAOC E1)
The Clean Fill Area is in the Class II-A ground water area. Three ground water samples within 200-feet of the surface water bodies in IAOC E3 and E2 (GMW-190, ESB-301, and ESB-54), one ground water sample within approximately 200-feet of the Former Tremley Tankfield Separator Outfall Ditch (ESB-5), and one ground water sample within 200-feet of Piles Creek (GMW-93) contain contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5).

Ground water elevation contours (Figure 5) indicate that ground water at GMW-190, ESB-301, and ESB-54 is not influenced by the three small surface water features, but instead flows toward Piles Creek, which is several hundred feet downgradient. There are a number of downgradient ground water samples that indicate that contaminants from these three wells are not discharging to Piles Creek. Therefore, the discharge of ground water into surface water from these three locations is not significant.

Eastern Landfill (IAOC E2)
The Eastern Landfill IAOC contains both Class II-A and Class III-B designated ground water areas (Figure 4). Therefore, each ground water area is discussed below in terms of its appropriate ground water classification – either Class II-A and/or Class III-B.

Class II-A Ground Water
Five ground water samples (L-10A, L-10C, L17-C, L-17D and L-9) within 200-feet of several unnamed surface water bodies contain contaminant concentrations of naturally-occurring constituents greater than 10 times the NJDEP Class II-A GWQC (Figure 5). Since the detected concentrations are for naturally-occurring constituents, such as iron, manganese, and/or sodium, and since this area is adjacent to the Class III-B ground water area, the discharge of ground water into surface water from these the Class II-A ground water area of IAOC E2 is not significant. Furthermore, these samples were not collected using low flow methodology and exceedances are associated with suspended sediment.

Class III-B Ground Water
No ground water sample within 200-feet of Morses Creek contains contaminant concentrations greater than the NJDEP Class III-B GWQC.

Central Landfill (IAOC E3)
The Central Landfill IAOC contains both Class II-A and Class III-B designated ground water areas (Figure 4). Therefore, each ground water area is discussed below in terms of its appropriate ground water classification – either Class II-A and/or Class III-B.

Class II-A Ground Water
Two ground water samples (L-11 and L-8) within 200-feet of several unnamed surface water bodies contain contaminant concentrations of benzene 100 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5).

Ground water elevation contours (Figure 5) indicate that ground water at L-11 is not influenced by the three small surface water features, but instead flows toward the Tremley Tankfield Outfall Ditch.

Class III-B Ground Water
No ground water samples within 200-feet of Morses Creek contain contaminant concentrations greater than the NJDEP Class III-B GWQC.

Western Landfill (IAOC E4) and Southern Landfill (IAOC E5)
The Western Landfill and the Southern Landfill are in the Class II-A ground water area. One ground water sample (L-22A) within approximately 200-feet of Morses Creek contained concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5). The last sample to exceed the criteria was in April of 1998. All subsequent sampling rounds in 2001, 2002 and 2003 were benzene was not detected.

Two ground water samples (GMW-107 and ESB-38) within 200-feet of the Tremley Tankfield Outfall Ditch contain contaminant concentrations of benzene 10 times greater than the NJDEP Class II-A GWQC (Table 5 and Figure 5).

The Western Landfill IAOC and the Southern Landfill IAOC are part of a larger Waste Management Area that is monitored quarterly by ExxonMobil under New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Ground Water (DGW) Permit.

Investigative Unit F
There are no surface water bodies within approximately 200-feet of Investigative Unit F (Figure 5).

Investigative Unit G
There are no surface water bodies within approximately 200-feet of Investigative Unit G (Figure 5).

As discussed above, it should be emphasized that in a conservative scenario, even if the groundwater plume has migrated into the surface water (specifically Morses Creek, which has the two dam systems), sampling required (under a NJPDES permit) would effectively limit the contamination discharging into the Arthur Kill. It should be noted that normally, due to the amount of water usage, it is necessary to pump additional water from the Arthur Kill to supplement the Morses Creek water usage.

However, as a conservative position taken for this documentation of the EI CA750, the discharge of "contaminated" groundwater into surface water is NOT likely to be "insignificant." (The discharge of "contaminated" groundwater into surface water can be shown to be "currently acceptable" as will be discussed in Question 6, which follows.)

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be **"currently acceptable"** (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

_X__ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and 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.

RATIONALE:

The discharge of ground water to surface waters at the Bayway Refinery is shown below to be currently acceptable, and should be allowed to continue until a final remedy decision can be made and implemented. This determination has been made (1) based on a comparison of surface

[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.

water quality data from potentially affected surface water bodies within and adjacent to the Bayway Refinery to basic water-quality criteria (i.e., New Jersey Surface Water Quality Standards at N.J.A.C. 7:9B et seq); and (2) with consideration of the ongoing and completed remedial activities at the Tank 510 Area, Greater Elizabeth Tankfield and the Sludge Lagoon Operable Unit; the final remedy design process underway at the Domestic Trade Terminal, Gasoline Blending Tankfield, Gasoline Component Tankfield, Pitch Area and East Side Chemical Plant IAOCs, and the Interim Remedial Measures currently conducted at the Domestic Trade Terminal, Caustic Tank No. 3, Spheroid No. 196, Cogen North Leasehold/Fuel Gas Area, No. 2 Dam Interceptor Trench, Tank No. 519 Area, and the Waterfront Barge Pier (see response to question 3 for complete description and details).

Some surface water bodies within and adjacent to the refinery have historic sediment contamination. Therefore, the potential contribution of current ground water discharge to sediment quality (and similarly, to the hyporheic zone) is beyond the scope of this ground water EI determination. Instead, sediment quality issues are being dealt with more broadly as part of the site-wide RI and ecological evaluation/risk assessment process being conducted with NJDEP oversight, as part of the on-going corrective action program towards a final remedy for the site.

In addition, as discussed previously, as a conservative scenario, even if the groundwater plume has migrated into the surface water (specifically Morses Creek, which has the two dam systems), sampling required (under a NJPDES permit) would effectively limit the contamination discharging into the Arthur Kill. It should be noted that normally, due to the amount of water usage, it is necessary to pump additional water from the Arthur Kill to supplement the Morses Creek water usage.

Surface Water Classification

As discussed in response to question 1, for the site-wide RI, the refinery was divided into Investigative Units (Units A through H) based on hydrogeologic conditions and site use (Figure 3). Investigative Unit H includes surface water. Surface water investigations have been conducted at the Bayway Refinery as part of the RI and IRM programs previously discussed. Approximately 104 surface water samples have been collected; all surface water data is stored in a searchable electronic database.

Ground water at the Bayway Refinery discharges to the surface waters of the Arthur Kill, Morses Creek (including the Peach Orchard Creek and West Brook Reservoirs, the Tremley Tankfield Outfall Ditch, the Poly Ditch and Condensor Ditch, Esen Basin, and an unnamed tributary to Morses Creek), and Piles Creek (Figure 5). The New Jersey Surface Water Quality Standards (SWQS) rule at N.J.A.C. 7:9B et seq. classifies surface water, and contains promulgated numeric surface water quality criteria based on that classification.

According to N.J.A.C. 7:9B-1.15(e) – Table 3, in the vicinity of the refinery, the Arthur Kill is classified as SE2. An SE classification is applied to saline waters of estuaries, or waters having salinities greater than 3.5 parts per thousand at mean high tide. Morses Creek is classified as

FW2-NT/SE3. An FW2-NT/SE3 classification applies to a waterway with a fresh water/salt water interface. For Morses Creek, the point of demarcation between the fresh and saline waters has been determined to be at No. 2 Dam (DRAI, 2000). In the fresh portions above No. 2 Dam (i.e., Peach Orchard Creek and West Brook Reservoirs), Morses Creek is classified as FW2-NT. In the saline portions below No. 2 Dam, Morses Creek (including the Tremley Tankfield Outfall Ditch and the unnamed tributary) is classified as SE3. Piles Creek is classified as SE3.

The SWQS rule (N.J.A.C. 7:9B-1.14(c)) includes surface water quality criteria for saline (SE) and fresh (FW) waters based on: aquatic life protection (acute and chronic); human health protection (carcinogenic and non-carcinogenic), and organoleptic effects.

Surface Water Quality Data

Surface water samples were collected during the Phase 1A and Phase 1B RI, and evaluated as part of the Baseline Ecological Evaluation (BEE). Media-specific benchmarks were used to identify and assess potential risks (Arthur D. Little, 2000a). The lower of EPA's chronic Federal ambient water quality (AWQC) or New Jersey surface water quality criteria (NJSWQC) was used to calculate surface water chemical-specific hazard quotients (HQs) and chemical group hazard indices (HIs). The study concluded that there are no significant surface water potential risks, except for some metals being driven by suspended sediments. **Therefore, surface water is not reasonably suspected to be contaminated above appropriate risk-based levels.**

These results are representative of conditions before implementation of the final remedy recently completed at the SLOU, and before implementation of the final remedies currently being designed under NJDEP oversight at the Domestic Trade Terminal, Gasoline Blending Tankfield, Gasoline Component Tankfield, Pitch Area and East Side Chemical Plant IAOCs. Refer to the response to question 3 for a complete description of the final remedy decision for these areas.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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:

As discussed in response to question 1, ExxonMobil conducted an RI at the Bayway Refinery in accordance with the ACO executed by ExxonMobil and NJDEP. The purpose of the RI was to delineate contamination exceeding applicable criteria. The RI was also performed to characterize the subsurface conditions (geologic and hydrogeologic) at the site. To best accomplish the goals of the ACO, the RI was conducted in a phased manner. The Phase 2 Remedial Investigation Report, which completed the delineation of contamination at the facility, was submitted in April 2004 (TRC Raviv, 2004b).

Existing areas of ground water contamination were identified during the Phase 1B RI (Arthur D. Little, 2000a). Ground water sampling data results from the Phase 2 RI indicate that the dimensions of the existing areas of ground water contamination (LOCs) remain essentially unchanged (TRC Raviv, 2004b). Therefore, the migration of contaminated groundwater can reasonably be considered to be stabilized, and is expected to remain within the existing areas of contaminated groundwater.

IRM activities, consisting of recovering free product and/or ground water from wells and sumps, are currently conducted with NJDEP oversight at seven (7) areas within the refinery: Domestic Trade Truck Terminal; Caustic Tank No. 3; Spheroid No. 196; Cogen North Leasehold/Fuel Gas; No. 2 Dam Interceptor Trench; Tank No. 519; and the Waterfront Barge Pier. These areas are discussed below. Over the years, the IRM activities have substantially diminished the free product thicknesses in monitoring wells. IRM activities are conducted on a regular schedule, and reported to the NJDEP on a quarterly basis (TRC Raviv, 2004d).

Remedial action activities have been completed at the following areas: Greater Elizabeth Tankfield (TRC Raviv, 2003a) and the SLOU (Shaw, 2003). Monitoring reports for the SLOU are submitted to the NJDEP on a quarterly basis. Remedial activities are currently being

conducted at the Former Tank 510 Area, and monitoring reports are submitted to the NJDEP on a quarterly basis (DRAI, 2004e).

Remedial action selection and design workplans for Domestic Trade Terminal, the Gasoline Blending Tankfield, the Gasoline Component Tankfield, the Caverns Area, East Side Chemical Plant (ESCP) and the Pitch Area include ground water monitoring provisions (TRC Raviv 2004c and 2004f; DRAI 2002c).

RASRs were prepared for the following areas (Figure 7): East Side Chemical Plant (ESCP); the Domestic Trade Terminal Area; the Gasoline Blending Tankfield; the Gasoline Component Tankfield; the Pitch Area; and the Caverns Area (DRAI 2002c, 2002e, 2002f and TRC Raviv 2003c, 2003d, 2004a).

As the corrective action activities at this site progresses toward a final remedy for the site, groundwater monitoring/measurement data (and surface water/sediment/ecological data, as necessary) will be collected to verify that contaminated groundwater remains within the horizontal and vertical dimensions of the "existing area of contaminated groundwater."

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

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 **ExxonMobil Bayway Refinery, EPA ID # NJD062037031, located at 1400 Park Avenue, Linden, New Jersey**. 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.

References

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8.

Reviewed by: _____ Date _____
Clifford Ng, RPM
RCRA Programs Branch
EPA Region 2

_____ Date _____
Barry Tornick, Section Chief
RCRA Programs Branch
EPA Region 2

Approved by: Original signed by: Date: August 29, 2005
Adolph Everett, Chief
RCRA Programs Branch
EPA Region 2

Locations where References may be found:

References reviewed to prepare this EI determination are identified in the appendices that follow Question 8. Reference materials are available at the USEPA Region 2, RCRA Records Center, located at 290 Broadway, 15th Floor, New York, New York, and the New Jersey Department of Environmental Protection Office located at 401 East State Street, Records Center, 6th Floor, Trenton, New Jersey.

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APPENDICES

Figures and Tables

The following figures and tables have been provided to support this EI determination:

Figure 1 – Site Location Map
Figure 2 – Aerial Photograph (2003)
Figure 3 – Investigative Units
Figure 4 – Investigative Areas of Concern (IAOCs)
Figure 5 – Ground Water Locations of Contamination (LOCs)
Figure 6 – Locations of Interim Remedial Measures (IRMs)
Figure 7 – Locations of Remedial Actions

Table 1 – Investigative Areas of Concern (IAOCs)
Table 2 – NJDEP Class II-A Ground Water Quality Criteria (GWQC) and Site-Specific Class III-B GWQC
Table 3 – Site-Wide List of Ground Water Contaminants of Concern (COCs) In Class II-A and Class III-B Areas
Table 4 – Ground Water Samples Located Within 200 Feet of Surface Water
Table 5 – Class II-A Ground Water Samples Within 200 Feet of Surface Water That Exceed Criteria By a Factor of 10 and/or 100
Table 6 – Class III-B Ground Water Samples Within 200 Feet of Surface Water That Exceed Criteria By a Factor of 10 and/or 100

Attachment 1 – Sample Designation System

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