FINAL

SITEWIDE REMEDIAL INVESTIGATION REPORT

FOR ALL OPERABLE UNITS
DUPONT CHAMBERS WORKS FUSRAP SITE
DEEPWATER, NEW JERSEY

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Prepared by:

U.S. ARMY CORPS OF ENGINEERS
PHILADELPHIA DISTRICT
PHILADELPHIA, PENNSYLVANIA

With Technical Support from:

CABRERA SERVICES
RADIOLOGICAL • ENGINEERING • REMEDIATION

1106 North Charles Street, Suite 300
Baltimore, MD 21201

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	Atomic Energy Commission
ANSI	American National Standards Institute
AOC	area of concern
AOI	area of interest
ARA	Applied Research Associates
ASTM	American Society for Testing and Materials
bgs	below ground surface
BNI	Bechtel National, Inc.
Bq/kg	becquerels per kilogram
BRA	Baseline Risk Assessment
BTEX	benzene, toluene, ethylbenzene, xylene
CABRERA	Cabrera Services, Inc.
CBWS	C-Basin Well Point System
CDD	Central Drainage Ditch
CENAP	U.S. Army Corps of Engineers, Philadelphia District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
cm	centimeter(s)
cms	centimeters per second
cm^2	square centimeters
COC	Chain of Custody
COPC	constituent of potential concern
cpm	counts per minute
CPT	cone penetrometer testing
CSM	Conceptual Site Model
DCGL	Derived Concentration Guideline Level
DE	Delaware
DGPS	differential global positioning system
DNAPL	dense non-aqueous phase liquid
DOE	U.S. Department of Energy
DO	dissolved oxygen
dpm	disintegrations per minute
DQO	Data Quality Objective
DRCAP	Delaware River Corrective Action Program
DuPont	E.I. DuPont de Nemours & Company
Eh	redox potential
EM	electromagnetic
°F	Fahrenheit
FIDLER	field instrument for detection of low energy radiation
FS	feasibility study
ft	feet
ft/day	feet per day
ft^2	square feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GIS	geographical information system
GM	Geiger-Mueller
gpm	gallons per minute
GPR	ground penetrating radar
GPS	global positioning system
GSSI	Geophysical Survey Systems, Inc.

GWS	gamma walkover survey
HPGe	High Purity Germanium Detector
HPWDS	Historic Process Water Ditch System
HSWA	Hazardous and Solid Waste Amendments of 1984
Hz	hertz
ID	inner diameter
IDW	Investigation Derived Waste
ISV	investigative screening value
IWS	Interceptor Well System
K-40	potassium-40
K	hydraulic conductivity
K_d	distribution coefficient of a contaminant between its soil-sorbed phase and its aqueous phase
Kg	kilogram
L	liter
LNAPL	light non-aqueous phase liquid
m	meter
m^2	meters squared
m/d	meters per day
MAG	magnetometer
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MDA	minimum detectable activity
MDC	minimum detectable concentration
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MHz	megahertz
mph	miles per hour
mV	millivolts
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µR/hr	microRoentgens per hour
µS/m	microSiemens per meter
µS/cm	microSiemens per centimeter
MED	Manhattan Engineer District
MS	matrix spike
MSD	matrix spike duplicate
NaI	sodium iodide
$Na_2U_2O_7$	sodium uranite
NAD	North American Datum
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NCP	National Contingency Plan
ND	non-detect
NGVD 29	National Geodetic Vertical Datum
NJ	New Jersey
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NRC	Nuclear Regulatory Commission
ns	nanosecond
NTU	Nephelometric Turbidity Unit
ORP	oxidation-reduction potential
OU	Operable Unit
ORNL	Oak Ridge National Laboratory
Pa-234m	protactinium 234 isomer
PAH	polycyclic aromatic hydrocarbon

Pb-206	Lead-206
PCB	polychlorinated biphenyl
pCi/g	picoCuries per gram
pCi/L	picoCuries per liter
pCi/µg	picoCuries per microgram
pH	Potential of Hydrogen: log of the hydrogen ion concentration
PID	photoionization detector
PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
Ra-226	Radium-226
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RFI	RCRA Facility Investigation
ROPC	Radionuclide of Potential Concern
SB	soil boring
SDG	Sample Delivery Group
SEM	scanning electron microscope
SVOC	semi-volatile organic compound
SWMU	solid waste management unit
TAL	Target Analyte List
TCL	Target Compound List
TD	thorium dioxide
TDMD	time domain metal detector
TEL	tetraethyl lead
Th-230	Thorium-230
Th-231	Thorium-231
Th-234	Thorium-234
TOC	total organic carbon
TPP	Technical Project Planning
TPU	total propagated uncertainties
U	Uranium
UF_4	Uranium tetrafluoride (green salt)
UF_6	uranium hexafluoride
U-234	Uranium-234
U-235	Uranium-235
U-238	Uranium-238
U_3O_8	black oxide
UO_2	brown oxide
$UO_4 2H_2O$	uranium peroxide dihydrate
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UTL	upper tolerance limit
UPL	upper prediction limit
VOC	volatile organic compound
V_s	seepage velocity
XRD	x-ray diffraction
Weston	Weston Solutions, Inc.
WQC	Water Quality Criteria
WWTP	wastewater treatment plant
yd^3	cubic yards

EXECUTIVE SUMMARY

ES. 1 Introduction

The U.S. Army Corps of Engineers (USACE)-Philadelphia District (CENAP) conducted a Sitewide Remedial Investigation (RI) for radiologically-contaminated areas at the DuPont Chambers Works facility (Chambers Works) in Deepwater, New Jersey (NJ). This report presents the results of field investigations conducted at three Operable Units (OUs) and summarizes the impacts of Manhattan Engineer District (MED)-related radionuclides to soil and groundwater as well as surface water and sediment in those areas of the facility. This work is being performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP), which was created by the U.S. Atomic Energy Commission (AEC) in 1974 to clean up radiological contamination at sites where work was performed in support of the nation's early atomic enery program. This work was conducted at sites across the country in the 1940s and 1950s primarily by MED and early AEC programs. Throughout this RI report MED will be used, for simplicity, to describe the work (as well as processes and contaminants) performed by DuPont in support of the nation's early atomic energy program whether or not the activities were performed by MED and/or AEC.

FUSRAP investigations were conducted at six Areas of Concern (AOCs) and were grouped into three OUs for investigation purposes. The OUs include the former MED production areas where uranium refining and recovery operations took place (OU 1); drainage areas leading away from production areas and a laboratory testing facility (OU 2); and MED disposal areas for building rubble, discarded equipment, and process wastes (OU 3). Weston Solutions, Inc. (Weston) conducted the investigation of OU 1 under contract to the USACE-Baltimore District, with Cabrera Services, Inc. (CABRERA) as a primary subcontractor. Investigations of OU 2, OU 3, and sitewide groundwater were performed by CABRERA. The results of each investigation have been integrated into this comprehensive Sitewide RI report.

ES. 2 Site Description and Background

The DuPont Chambers Works site is owned and operated by E.I. DuPont de Nemours & Company. It is an active chemical manufacturing facility located in Pennsville and Carneys Point Townships, along the southeastern shore of the Delaware River, north of the I-295

Delaware Memorial Bridge, and adjacent to the residential community of Deepwater, NJ. The facility has operated continuously since the late 1800s to produce various dye and specialty chemical products. Various chemical manufacturing and disposal activities have occurred at the property over the last century.

In the 1940s under contract to the U.S. government (MED and later AEC) DuPont processed uranium oxides and uranium-bearing scrap to produce uranium tetrafluoride, uranium hexafluoride and small quantities of uranium metal at Chambers Works. These operations took place from 1942 through 1949. No enrichment or depletion processes were conducted at Chambers Works.

All uranium processing took place in OU 1 (AOCs 1 and 2). Chambers Works converted scrap and dross (the scum that forms on the surface of molten metal) into uranium peroxide dihydrate in AOC 1, Buildings 101 and 102, later collectively called Building 845. During processing, 5,486 tons of scrap material was converted to 982 tons of black oxide (U_3O_8). In AOC 2 uranium peroxide and other oxides were processed in Buildings 708 and 205, ultimately producing (through several steps) uranium tetrafluoride and uranium metal.

In the 1950s and 1960s AEC conducted decontamination and cleanup activities at the Site based on existing cleanup standards of the time. In 1978 the U.S. Department of Energy (DOE), the successor agency to AEC, investigated the site for potential MED-related contamination and added Chambers Works to the FUSRAP program in 1980. Additional evaluations were conducted in 1983 to evaluate and cleanup any residual MED contamination. From these evaluations six areas were identified as possibly requiring further investigation and cleanup.

In October 1997, Congress transferred authority for the administration and execution of FUSRAP from DOE to USACE pursuant to the Energy and Water Development Appropriations Act of 1998 (Public Law 105-62). The Site is currently being addressed under FUSRAP and managed by the USACE under the legislative authority provided by the 2000 Energy and Water Development Appropriations Act (Public Law 106-60). This law established the authority of the USACE to conduct response actions for releases related to the nation's early atomic energy program subject to the provisions of the Comprehensive Environmental Response,

Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

ES. 3 Purpose and Goals of the Remedial Investigation

The purpose of the Sitewide RI was to characterize the nature and extent of contamination in various environmental media (soil, sediment, surface water, and groundwater) that may have resulted from previous MED-related operations at OUs 1, 2 and 3. The USACE's investigations began in 1998 after FUSRAP was transferred from DOE to USACE. Initial activities performed included a detailed records review including interpretation of aerial photographs dating back to pre-MED time period (early 1940s) (URS-Dames & Moore 2000 and Weston 2001). Intrusive investigations were then conducted in a phased approach at the three OUs between 2002 and 2007. A supplemental review of historical documents and aerial photographs was conducted for OU 3 to further evaluate MED-related disposal and rubble areas in AOCs 4 and 6 (CABRERA 2006c). Investigations for the three OUs were planned and executed in accordance with a set of approved project work management and field sampling plans relative to each OU and the results have been compiled and presented in this Sitewide RI report.

A Baseline Risk Assessment (BRA) including both Human Health and Ecological Risk Assessments was performed in support of this Sitewide RI and is presented as a separate companion volume to this report.

Distinct from the USACE's FUSRAP investigations DuPont is conducting Resource Conservation and Recovery Act (RCRA) corrective actions at the site, in accordance with its Hazardous and Solid Waste Amendments (HSWA) permit issued by the U.S. Environmental Protection Agency (USEPA). The HSWA permit and an agreement between the New Jersey Department of Environmental Protection (NJDEP) and DuPont set forth the necessary corrective actions to address contamination related to DuPont's chemical production activities at Chambers Works. Currently DuPont has identified and is in the process of evaluating more than 60 Solid Waste Management Units (SWMUs) located on the Chambers Works and Carneys Point properties under the RCRA program as a result of its chemical manufacturing and past disposal practices. For reporting purposes DuPont grouped the areas of MED activity, referred to as AOCs under FUSRAP, into SWMU 33. It is important to note that this is a designation only

used by DuPont and that the USACE does not use or recognize the SWMU 33 designation. Presently DuPont is not conducting any RCRA corrective actions in these areas. After FUSRAP remedial actions are completed, any non-MED-related constituents will be the responsibility of DuPont and addressed under its corrective action program.

ES. 4 Scope of Investigation

The scope of the FUSRAP investigation and potential response actions is defined by the USACE document ER 200-1-4: Environmental Quality – Formerly Utilized Sites Remedial Action Program FUSRAP – Site Designation, Remediation Scope, and Recovering Costs (USACE, 2003) and constrained by geographic area and eligible contaminants. The geographic scope is generally defined as any area used for activities in support of the nation's early atomic energy program.

The RI was conducted for the OUs and AOCs that meet the geographic eligibility criteria. OU 1 consists of Former Building 845 (AOC 1) and F Corral (AOC 2). These former MED production areas were the sites of uranium refining and recovery operations. OU 2 consists of the Central Drainage Ditch (CDD) (AOC 3) and the Building J-26 Area (former location of Building J-16) (AOC 5). The CDD includes the drainage ditches that lead away from the uranium production areas and through which the MED processing wastes were discharged. AOC 5 was the site of a former laboratory and small scale testing facility. OU 3 includes the Historical Lagoon A (AOC 4) and the East Area (AOC 6) and areas where building rubble, discarded equipment, and process wastes were disposed.

Detailed descriptions of the location and operational history of each AOC within the three OUs are presented in subsection 1.5 of this RI. The RI results for OU 1, OU 2, and OU 3 are described in Sections 4.0, 5.0, and 6.0, respectively.

As stated previously, only specific contaminants are eligible for cleanup under FUSRAP. The types of hazardous substances considered within the scope of FUSRAP are described in ER 200-1-4 (USACE 2003). To determine the FUSRAP-eligible contaminants at Chambers Works, the USACE reviewed historical site records, the use of specific compounds and feedstock materials at the Site, and general industry references describing similar processes at other facilities.

USACE listed and evaluated the potentially eligible radionuclides and chemicals that were mentioned in the MED contract documents. USACE then used a screening process to identify those radiological and chemical constituents that may be eligible for investigation and cleanup under FUSRAP. As a result of the screening process five radionuclides and no hazardous substances or chemicals were determined to be eligible contaminants (CABRERA 2011a). The eligible contaminants are further discussed below.

Earlier Site investigations concluded that MED-related radiological contamination is limited to isotopes of refined uranium (i.e., U-234, U-235, and U-238) and their short-lived decay progeny (Weston 2001 and 2004). The term "refined" in this context refers to uranium with uranium isotopes in isotopic equilibrium but with non-uranium daughters either substantially reduced or removed. Refined natural uranium, initially identified as the primary site contaminant, is in a state of secular equilibrium with its short-lived decay progeny, which consist of daughter radionuclides with half-lives short enough to allow them to decay at the same rate at which they are produced. Based on the assumption that the original uranium refinement processes were performed approximately 60 years ago, only the short-lived uranium decay progeny and the three parent isotopes (U-234, U-235 and U-238) would be expected to be present today. These parent and progeny radionuclides include parent U-238, progeny Thorium-234 (Th-234) (24-day half life) and protactinium 234 isomer (Pa-234m) (1.17-minute half-life) and parent U-234. U-234 has insignificant decay progeny that are expected to be present. Parent U-235 and progeny Thorium-231 (Th-231) (25-hour half-life) would also be expected to be present.

Subsequently, thorium (Th-230) and radium (Ra-226) were also added to the list of radionuclides of potential concern (ROPCs) due to the potential for impurities to exist in the original uranium feedstock (Black Oxide, U_3O_8) used at Chambers Works. Impurities may result from the chemical separation process used to create the feedstock from natural uranium. The two radionuclides anticipated to remain today from the original feedstock contaminants would be Th-230 and Ra-226 due to their half-lives of 75,000 years and 1,600 years, respectively.

The USACE reviewed Site data and historical records and tested this assumption using site specific and theoretical (calculated) Th-230 and Ra-226 concentrations. A data evaluation was performed to compare maximum observed Th-230 and Ra-226 concentrations with respect to the

expected in-growth concentration of those radionuclides from their parent products, U-234 and U-238. Because observed concentrations were significantly higher than the expected concentrations (three times higher) for both radionuclides it was concluded that the excess concentrations of Th-230 and Ra-226 are due to the presence of impurities in the original MED feedstock. Therefore, the following five ROPCs are determined to be eligible for FUSRAP investigation and potential remediation at Chambers Works: U-234, U-235, U-238, Th-230, and Ra-226 (CABRERA 2011a).

Although no chemical or hazardous substances were identified as eligible contaminants for the Site, USACE collected and analyzed environmental media for non radiological contaminants (i.e., volatile and semi-volatile organics and metals) in order to evaluate health and safety measures and investigative-derived waste (IDW) disposal options. Although these chemical constituents were not identified as Constituents of Potential Concern (COPCs) for the RI, the data was obtained to assist in the characterization of chemical risks as part of the BRA. Target Analyte List (TAL) metals and Target Compound List (TCL) volatile and semi-volatile organic data were obtained to assist in the characterization of chemical risks as part of the draft BRA. Metals analysis for groundwater also provided useful information for the interpretation of geochemical conditions.

An investigative screening value (ISV) was initially developed for the RI in order to establish boundaries of MED-related contamination based on the uranium isotopes U-234, U-235 and U-238. These three isotopes were the original ROPCs for the site. This ISV was developed by utilizing the incremental screening values Derived Concentration Guideline Levels (DCGLs) of 10 picoCuries per gram (pCi/g) for U-238, 10 pCi/g for U-234, and seven pCi/g for U-235 presented in Table 1A of the New Jersey Administrative Code (NJAC) 7:28-12.

An evaluation of the sensitivity of the radiological field instruments and on-site laboratory was also performed and the results concluded that the on-site gamma spectroscopy laboratory provided an acceptable level of sensitivity. Investigative results were compared to the ISV and used to plan additional sampling activities and define the extent of contamination in all OUs.

ES. 5 Investigative Methods

The USACE conducted a phased, multi-media environmental investigation at the three OUs from 2002 through 2007. The field programs for each OU were planned and executed on different schedules and employed different drilling and investigative methods based on area-specific surface and subsurface conditions. The sampling strategies used were consistent with Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance in Chapter 5, *Survey Planning and Design* (DOD, et al., 2000). The sampling was designed to be consistent with characterization surveys and not final status surveys. Sampling strategies incorporated both unbiased (grid) and biased sampling.

Table ES-1 summarizes the investigative methods used at each OU. A variety of field investigative methods were utilized throughout the Sitewide RI and were tailored to the specific surface and subsurface conditions encountered in each AOC. Geophysical surveys provided a cost-effective means of locating subsurface utilities and other features that could potentially interfere with intrusive soil sampling activities. Survey methods included electromagnetic (EM), ground penetrating radar, and magnetometer (MAG) methods.

Gamma walkover surveys (GWS) were conducted in all AOCs except for AOC 5 in order to map near-surface areas of potential radiological impact and support the selection of additional (biased) sampling locations. A test pit program was only conducted in OU 1 to support the soil investigation within uranium source zones. A variety of techniques were used during the field program to assess the subsurface conditions and evaluate the horizontal and vertical extent of MED-related contamination. Soil boring and well installation program was initiated in each AOC. Depending on the surface and subsurface materials expected at each AOC several different methods were used and are summarized in Table ES-1.

During the groundwater investigation temporary piezometers were installed and samples collected for laboratory analysis. A monitoring well program was designed to confirm the extent of aqueous uranium and evaluate the mobility of uranium in groundwater in OU 1 and OU 3. Temporary piezometers were installed in OU 2. Since no uranium was encountered in groundwater in OU 2 piezometers (AOCs 3 and 5) no monitoring wells were installed at these locations. A groundwater quarterly sampling program was conducted over six consecutive

quarters in OU 1 wells and four consecutive quarters in OU 3 wells to evaluate hydrogeologic conditions, groundwater quality trends, and the extent of aqueous uranium contamination within the A, B, and C Aquifers.

ES. 6 Physical Characteristics of Site

Geology and Hydrogeology

Native soils encountered at the Site are alluvial and palustrine (marsh) deposits. These deposits over time have been modified by landfilling and construction activities. As the chemical manufacturing areas expanded, low-lying areas were filled in with river dredgings and other to form a foundation for further development. The upper 10 feet (ft) of the subsurface is typically composed of fill material.

The sedimentary deposits beneath the Chambers Works can be divided into five major sequences: (1) the A and B surficial aquifers and the A-B and B-C aquitards. The A-B aquitard is discontinuous and thins to zero to the east and in areas where stream channels were once present. The A aquifer is the uppermost water-bearing zone at the Chambers Works facility. The B aquifer consists of sands that are interpreted to be Delaware River alluvium; (2) the C aquifer, which is composed mainly of Pleistocene-age coarse-grained sands and gravels; (3) the C-D aquitard, which is composed of clays and silts of estuarine origin; (4) the D aquifer, consisting of coarse-grained sands and gravels. The D unit is valley-fill sediment that is incised in the underlying Potomac Group; and (5) the underlying D-E aquitard through the F Aquifer units are the Cretaceous-Age sediments of the Potomac Group. Although the surficial aquifers (A through D) are not a source of drinking water, the deeper Potomac Group aquifer is widely used as a drinking water source in southern NJ and DE.

ES. 7 Nature and Extent of Contamination

The nature and extent of contamination was defined by identifying areas of total uranium concentrations exceeding the ISV of 14 pCi/g. In general, elevated concentrations of Ra-226 and/or Th-230 above background concentrations were typically found in or in close proximity to uranium source areas. Groundwater contamination was evaluated and delineated by total uranium concentrations exceeding the USEPA Maximum Contaminant Level (MCL) of 30

micrograms per liter (µg/L). A summary of the nature and extent conclusions for OUs 1, 2, and 3 is provided in Table ES-2.

OU 1 Investigation Results

AOC 1

The horizontal boundaries of uranium contamination for AOC 1 encompass the Uranium Oxide Area (including the area between the wooden trough and the east side of Former Building 845); potential residual contamination areas within and adjacent to the wooden trough and the CDD; and areas within the building's footprint and to the west of Former Building 845. The vertical extent of contamination has been bounded by the identification of discrete depth intervals of contamination up to 4.5 ft below ground surface (bgs) within the building footprint and the Uranium Oxide Area, and at the 5.5 ft bgs interval in the southwestern portion of the AOC. The area of soil contamination using the ISV has been estimated to encompass 1.1 acres of AOC 1.

With the exception of one surface soil sample reported to contain 27,600 pCi/g, the maximum total uranium concentration in soil collected from the Uranium Oxide Area was 677.4 pCi/g at 1.5 ft bgs. Potential soil contamination above the ISV in the northern portion of AOC 1 was located at a depth of 1.5 ft bgs and ranged from 85 to 127 pCi/g. In contrast, the deepest soil sample exceeding the ISV beneath Former Building 845 was encountered at 4.5 feet bgs (579 pCi/g). In the southwestern portion of AOC 1 near the boundary with AOC 2, contaminated soil exceeding the ISV was reported to a depth of two ft bgs (149 pCi/g).

In general elevated Ra-226 and Th-230 concentrations were identified at locations within or in close proximity to uranium source areas. Ra-226 results in soil range from 0.4 to 2.3 pCi/g. Th-230 results in soil range from 0.4 pCi/g to 64 pCi/g.

AOC 2

The horizontal boundaries of potential MED-related uranium for the F Parking Corral Area encompass the potential source area of the Former Building 708 and potential residual contamination areas within and adjacent to the northern drainage ditch and the northern portion of the CDD that traverses AOCs 1 and 2. The vertical extent of potential MED uranium was

reported to extend to a depth of 11 ft bgs, with highest activity observed in the two to four ft depth interval. The potential soil contamination has been estimated to encompass 1.7 of the 8.5 acres within AOC 2.

For borings associated with Building 708, those located outside the building footprint exhibit soils with uranium concentrations above the ISV at depths of less than 3.5 ft bgs, with a maximum concentration of 800 pCi/g in the 1.5 ft bgs interval. Within the building footprint, potentially contaminated soils were detected at depths of up to 11 ft bgs, with the highest concentrations detected at four ft bgs (4,832 to 16,584 pCi/g). Between the 4.5 to seven ft bgs interval, total uranium ranged from 23 to 2,180 pCi/g. A soil sample with a result of 1,050 pCi/g was reported at the 11 ft depth. Only two of the borings within the building footprint showed uranium concentrations above the ISV at discrete intervals, all other borings exhibited contaminated soils across depth intervals. Depth of contaminated soil in the northeast portion of the AOC near the CDD was limited to the first 0.5 to 1.5 ft bgs (132 to 385 pCi/g). The soil sample result of 385 pCi/g was located at 2BH042.

Elevated Ra-226 and Th-230 concentrations were identified at locations within or in close proximity to uranium source areas in AOC 2. Ra-226 results in soil range from 0.37 to 2.87 pCi/g. Th-230 results in soil range from 0.19 pCi/g to 15 pCi/g.

OU 1 Groundwater

The extent of uranium contaminated groundwater has been identified in OU 1. Of the 25 wells sampled, six A aquifer and two B aquifer wells were impacted. No uranium impacts to the C aquifer were observed. In the A aquifer, average (over time) uranium concentrations within the three AOC 1 impacted wells ranged from 109 µg/L to 26,317 µg/L. The three impacted A aquifer wells in AOC 2 contained average uranium concentrations between 168 µg/L and 14,027 µg/L. The approximate total area of the A Aquifer impacted by uranium is 20,000 square feet (ft^2) (0.5 acres). Uranium concentrations in the two B aquifer wells in AOC 2 ranged from 167 µg/L to 29,560 µg/L. The total area of the B Aquifer impacted is approximately 8,000 ft^2 (0.2 acres). In general, remaining wells exhibited uranium concentration of less than 5.0 µg/L.

A light, non-aqueous phase liquid (LNAPL) was sampled from well 2-MW-01. The LNAPL did not contain uranium concentration above background levels. The LNAPL appears to be coal tar or coal-tar distillate (from dye production) with a mixture of other compounds. Well observations noted similar LNAPL in two additional wells in OU 1 (2-MW-03 and 2-MW-05).

OU 2 Investigation Results

AOC 3

Sixteen of the 209 samples (8%) had uranium activities in exceedance of the ISV. Elevated uranium was detected up to eight ft bgs. The maximum concentration of 365 pCi/g was reported at a depth of four to five ft bgs. This boring was located to the east of the current drainage ditch and south of the historic drainage ditch in the vicinity of the lagoon. The location is believed to be in a DuPont disposal cell area along a berm that was built up over the years with dredge spoils from the lagoon. This elevated sample is not believed to be representative of potential MED contamination. One sediment sample collected during the gamma walkover in the middle section of the CCD contained 79.6 pCi/g total uranium. This sample was collected in the middle reach of the CDD and was submitted for scanning electron microscope (SEM) and x-ray diffraction (XRD) for mineral analysis (WES, 2003). The assemblage of minerals detected was consistent with fluorspar feedstock that is used to manufacture hydrofluoric acid. The analysis is provided in the WES report and included in Appendix R.

No filtered groundwater sample exceeded the MCL of 30 µg/L for uranium. Unfiltered groundwater samples were collected but the results were believed to be biased high due to the lack of a filter pack around the temporary piezometers. Two monitoring wells were installed in AOC 3 and have been incorporated into the OU1 groundwater discussion. No total uranium was detected above the MCL in any of the 13 surface water samples. Of the 30 sediment samples analyzed for total uranium, five exceeded the ISV of 14 pCi/g, with all of these exceedances being reported from two locations within the 'wooden trough' area of the CDD.

AOC 5

Uranium was not encountered above the ISV in soils in AOC 5, and uranium activities in groundwater were one picoCurie per liter (pCi/L) or less in all filtered samples. Historical

records indicate that soils and foundations of former Building J-16 were excavated. RI data results support those historical records. Uranium activities in groundwater were one pCi/L or less in all filtered piezometer samples; while some unfiltered groundwater samples exceed the MCL, results were believed to be biased high due to the lack of a filter pack around the temporary piezometers. Four DuPont B aquifer monitoring wells located in AOC 5 were sampled in July 2007. No total uranium results exceeded the MCL of 30 µg/L. The maximum total uranium concentration detected in the four wells was 1.29 µg/L (Well C08-M01B).

OU 3 Investigation Results

The primary source of potential contamination in OU 3 is believed to be in the form of contaminated rubble, equipment and materials that may have been disposed onsite during MED operations. Historical data indicate that much of the site was developed on top of construction fill resulting from onsite building demolition. Fifty-one soil samples were obtained from a total of 28 soil borings in AOC 4. Ninety-one soil samples were obtained from a total of 49 soil borings in AOC 6. Surface water and sediment samples were also collected in this AOC.

AOC 4

Seven soil samples contained total uranium concentrations that exceeded the ISV of 14 pCi/g. The highest concentration of total uranium measured in AOC 4 soil was collected from cores obtained during the drilling of well 4-MW-06, where soil from a depth of eight ft bgs had a reported total uranium concentration of 355 pCi/g. An additional six soil boring locations exhibited uranium concentrations in excess of the ISV, three at depths of seven to nine ft bgs and to a lesser extent, three at depths up to 3.5 ft bgs.

The uranium source areas have been identified as the process waste settling basin that received effluent from the CDD and in the form of contaminated materials disposed in the AOC. All locations exhibiting contaminated soils were located in the northern part of the AOC, Area of Interest (AOI 1). This area is in the vicinity of DuPont's SWMU 5. All soil contamination was at discrete intervals within each boring to depths of 10 ft bgs. With the exception of one surface soil sample, the maximum concentration was observed at eight ft bgs (355 pCi/g). The surface soil sample demonstrating a higher concentration of total uranium consisted of a piece of rubber

that contained 11,700 pCi/g total uranium. Further sampling revealed that the elevated uranium was isolated to the piece of rubber and not in the adjacent areas around it.

Elevated Ra-226 and Th-230 concentrations were identified at locations where elevated uranium concentrations were found. Ra-226 results in soil range from 0.2 to 4.4 pCi/g; Th-230 results in soil range from 0.5 to 26 pCi/g.

AOC 4 Groundwater

In AOC 4, only one well, I17-M01A, consistently exceeded the MCL of 30 µg/L with an average uranium concentration of 145 µg/L. This well is placed within DuPont SWMU 5 area. All other A aquifer wells had average uranium concentrations below the MCL. Sample results from the two B Aquifer wells sampled in AOC 4 (4-MW-01B and H17-M02B) consistently had total uranium results less than one µg/L.

AOC 6

Twenty-eight samples contained total uranium concentrations that exceeded the ISV of 14 pCi/g. In general, soil depths for ISV exceedances were less than six ft bgs, with 18 boring locations exhibiting elevated uranium concentrations up to this depth. These borings are in the East Burial Area. Four locations in the Firefighter Training Area (AOI 6) exhibited deeper soil contamination at depths between six and 12 ft bgs. The highest concentration of total uranium measured in AOC 6 soil was collected from a depth of one to two ft bgs (3,910 pCi/g).

The uranium source area has been identified as East Burial Area, currently located under and to the north of East Road. MED scrap and waste were reportedly buried there along with DuPont radioactive waste.

Soils in AOI 4 (East Area) were potentially contaminated above the ISV at depths less than four ft bgs. Most potentially contaminated soils were detected at discrete intervals within each boring; only two borings were potentially contaminated between the surface and two ft bgs depth. With the exception of one surface soil sample with total uranium at 1,280 pCi/g, the highest concentration of total uranium was at the depth of one foot bgs at 3,910 pCi/g. The total area of soils impacted above the ISV in AOC 6-AOI 4 is approximately 4800 ft^2 (0.1 acres).

Soils in AOI 6 (Fire Fighter Training Area) exhibited deeper soil contamination at discrete depth intervals between six and 12 ft bgs; the maximum total uranium concentration at this depth was 153 pCi/g.

Elevated Ra-226 and Th-230 concentrations were identified at locations where elevated uranium concentrations were found. Ra-226 results in soil range from 0.3 to 14.3 pCi/g; Th-230 results in soil range from 0.17 to 1.0 pCi/g.

AOC 6 Groundwater

Seven groundwater monitoring wells were installed in the B Aquifer at AOC 6. The A aquifer is not present in AOC 6. Although the aquifer extends at least 50 ft bgs beneath AOC 6, uranium impact is limited to the upper part of the aquifer. The screened interval for deep well 6-MW-07 was from 40 ft to 50 ft bgs beneath the uranium source area and uranium concentrations at this location were less than one µg/L. One of the seven wells exhibited total uranium concentrations exceeding the MCL of 30 µg/L, with an average uranium concentration of 267 µg/L. The remaining wells in AOC 6 had uranium concentrations below the MCL, and all average values were less than 5.2 µg/L. The extent of impacted groundwater above the MCL in the B Aquifer is estimated to be from 3,000 to 5,000 ft^2, or less than 0.1 acre.

One of 12 surface water samples exceeded the MCL of 30 µg/L (a concentration of 265 µg/L), while one of the 13 sediment samples exceeded the ISV of 14 pCi/g (a concentration of 18.4 pCi/g).

ES. 8 Fate and Transport

The fate and transport of uranium compounds was assessed to identify the environmental media that could be potentially impacted due to contaminant migration. The primary release mechanisms or migration routes identified were: the leaching of surface or subsurface source materials into vadose zone soils and/or shallow groundwater; contaminant particles dissolving into groundwater; contaminants migrating from the shallower A Aquifer into the deeper B Aquifer; contaminants moving from groundwater to surface water and sediments; surface water and sediments migrating downstream; and stormwater runoff carrying contaminants from source materials to surface soils and drainage ditches

Potential transport mechanisms include groundwater, surface water, sediment, air, and direct contact. A generalized Conceptual Site Model (CSM) was developed for the Site to describe the complete exposure pathways based on release mechanisms and migration pathways. The generalized CSM is presented in Section 7.0 of the Sitewide RI. A specific CSM for each OU and/or AOC was developed and is presented in the BRA.

Advection and dispersion is the primary potential transport mechanism for dissolved uranium in onsite soil. Dissolved contaminants could potentially travel along pathways formed by soil pores between individual grains of sand, silt, and gravel. Colloid-facilitated transport of uranium has not been observed in on-site soil. The possibility for this kind of transport was tested by comparing filtered and unfiltered aliquots of groundwater during low-flow groundwater sampling. The sampling and analytical results indicated that heavy-metal colloids were not present.

Processes that tend to attenuate the dispersion of metals include retardation resulting from their sorption to aquifer solids and precipitation. Sorption reactions are more likely to occur on clay and silt particles, with very little sorption to sand. In OU 1, the subsurface soil profile includes the presence of a silty clay layer (referred to as the AB Aquitard) located under most of AOC 1 and AOC 2. It would be expected that sorption may be a factor in retarding the migration of contaminants where these clay layers are present.

Uranium is found in six oxidation states ranging from U(1+) to U(6+), with tetravalent uranium [U(4+)] and hexavalent uranium [U(6+)] being the most common oxidation states of uranium in nature. The tetravalent form ordinarily occurs in reducing environments while the hexavalent form is prevalent in oxidizing environments (USEPA 1999). Both low solubility uranium oxide compounds, such as pitchblende (black oxide, U_3O_8), and uraninite (brown oxide, UO_2), and the more soluble U(+6) compounds, such as metastudite and uranophane (a calcium-uranyl silicate), have been detected at OU 1. Metastudite and uranophane were encountered in the "Yellow Oxide Area," which is located in the area of the former loading dock (Building 845).

The aqueous solubility of a compound is an important transport parameter in groundwater because it determines the concentration of the dissolved phase. The oxidation reduction (redox)

potential of the subsurface conditions is the primary controlling factor determining uranium solubility. In general, the higher valence state uranium compounds are more likely to be found in oxidizing environments. These soluble uranium compounds are less likely to partition, or sorb, onto soil or sediment particles, and will therefore be more mobile. Conversely, low-solubility uranium compounds, like uraninite, are more likely to be found in reducing environments, and therefore less mobile in the environment.

Uranium mobility has been evaluated in Section 7.0 of the Sitewide RI. In general, geochemical conditions in OU 1 (AOCs 1 and 2) indicate groundwater with neutral pH, high sulfate concentrations, and oxidizing to slightly reducing conditions. Geochemical conditions in OU 2, AOC 3 indicate an oxidizing environment, which is favorable to the formation of colloids or complexes, and enhanced mobility. In contrast, OU 3 conditions indicate a strongly reducing environment, which would not promote colloid formation and subsequent transport. OU 3 data will need to be further monitored to evaluate these assumptions.

ES. 9 Conclusions

The results of the OU 1, OU 2, OU 3, and groundwater investigations are summarized in Section 8 of this report. The results of the RI indicate that the largest extent of potentially contaminated soils and groundwater are located within the boundary of OU 1. Soil locations containing elevated concentrations of total uranium are associated with identified source zones (i.e., former building footprints and the Uranium Oxide Area). The potential soil contamination has been estimated to encompass 1.1 acres of the 3.2 acres contained within AOC 1, and 1.7 acres of the 8.5 acres contained within AOC 2. While both the A and B aquifers have been impacted within OU 1, the extent of groundwater contamination is limited (0.5 acres within the A aquifer and 0.2 acres within the B Aquifer). No uranium impacts to the C aquifer in OU 1 were observed. Geochemical conditions within both aquifers in OU 1 are indicative of slightly reducing conditions, which may serve to limit the solubility and subsequent migration of uranium compounds.

The OU 2 soils investigation results indicate that discrete areas of potentially contaminated soil using the ISV exist within the eastern portion of the CDD in current or former ditch locations and adjacent to DuPont's SWMU 16, the former C Basin (a closed disposal cell under RCRA). RI sampling efforts inadvertently located one soil boring location within this disposal cell (3-SB-

39). This sample is not considered as defining the extent of MED contamination since other radioactive materials, not related to MED, are likely found in this closed cell. In addition, this sample is not included within the BRA data set. Sediment contamination exceeding the ISV was limited to the 'wooden trough' area of the CDD. No soil contamination exceeding the ISV contamination was found in AOC 5. While no groundwater contamination was identified within OU 2, geochemical conditions in AOC 3 are oxidizing and suggest that uranium could be mobilized here.

Potentially contaminated soils and groundwater are also located within OU 3, although to a lesser extent than in OU 1. Within AOC 4, all locations exhibiting potentially contaminated soils were located in the AOI 1 in the northern part of the AOC (DuPont SWMU 5 area). Within AOC 6, only two of seven AOIs (AOI 4 and AOI 6) contained potentially contaminated soil. The total area of impacted soils in AOC 6-AOI 4 is approximately 4800 ft^2 [0.1 acres], while the extent within AOC 6 AOI 6 is limited to discrete intervals at four sampling locations. Soils with uranium concentrations above the ISV in AOI 6 were typically encountered between 6.5 to 10.5 ft bgs.

Results of the surface water and sediment sampling within AOC 6 indicated that there are essentially no impacts, and that any potentially contaminated soils washed into the ditch have not migrated. The single surface water sample (of 13 collected) that exhibited elevated total uranium was turbid and was collected near MED related uranium existing at the surface of the northern bank of the ditch. Only one of 13 sediment samples contained elevated uranium.

Groundwater contamination within the A aquifer is limited to one well in AOC 4 which is located within a uranium-impacted area and adjacent to an identified area of potentially contaminated soils. The A aquifer is not present in AOC 6; the extent of groundwater contamination within the B aquifer in this portion of OU 3 is also limited to one well located downgradient of an area of potentially contaminated soils. The estimated extent of impacted groundwater is 3,000 to 5,000 ft^2, or less than 0.1 acre. Similar to OU 1, groundwater geochemistry indicates the presence of reducing conditions.

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE)-Philadelphia District (CENAP) is conducting a sitewide Remedial Investigation (RI) for radiologically-contaminated areas at the DuPont Chambers Works facility (Chambers Works) in Deepwater, New Jersey (NJ). This report presents the results of field investigations conducted at three Operable Units (OUs) and summarizes the impacts of the Manhattan Engineer District (MED)-related radionuclides to soil, groundwater, surface water and sediment in those areas of the facility. Cabrera Services, Inc. (CABRERA) performed the investigation of OUs 2 and 3 under contract to the USACE. Weston Solutions, Inc. (Weston) conducted the investigation of OU 1 under contract to the USACE-Baltimore District, with CABRERA as a primary subcontractor. The results of each investigation have been integrated into this comprehensive Sitewide RI report.

This work is being performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP), which was created by the U.S. Atomic Energy Commission (AEC) in 1974 to clean up radiological contamination at sites where work was performed in support of the nation's MED and early AEC programs. Throughout this RI report "MED" will be used to describe the processes, contaminants, and work related to the nation's early atomic energy program whether or not the activities were performed by MED or AEC.

The DuPont Chambers Works site is a 1,455 acre complex which includes the Chambers Works chemical manufacturing area (referred to as Chambers Works) and the former Carneys Point Smokeless Powder Works (referred to as Carneys Point Works). Various chemical manufacturing and disposal activities have occurred at the site over the last century. The Chambers Works facility has operated continuously since the late 1800s to produce various dye and specialty chemical products. The site is located in Pennsville and Carneys Point Townships, along the southeastern shore of the Delaware River, north of the I-295 Delaware Memorial Bridge, and adjacent to the residential community of Deepwater, NJ. The location of the DuPont property is shown in Figure 1-1. The complex is owned and operated by E.I. DuPont de Nemours & Company (DuPont) and is currently zoned for industrial use.

DuPont, the U.S. Environmental Protection Agency (USEPA) and New Jersey Department of Environmental Protection (NJDEP) include both the Carneys Point Smokeless Powder Works and Chambers Works in their description of the 1,455 acre complex. MED processing, research, and disposal areas were located only within the 700 acre Chambers Works site. Since no MED processing activities or waste disposal occurred within the Carneys Point Works site, located in the northern portion of the property, this area is not part of this FUSRAP investigation.

Historical operations at Chambers Works involved the processing of uranium oxides and uranium scrap to produce uranium hexafluoride and small quantities of uranium metal under various contracts with MED and AEC in support of the nation's early atomic energy program. These operations took place from 1942 through 1949. AEC conducted decontamination and cleanup activities in the 1950s and 1960s based on existing cleanup standards of the time. In 1978 the U.S. Department of Energy (DOE), the successor agency to AEC, investigated the site for potential MED-related contamination and added Chambers Works to the FUSRAP program in 1980. On October 13, 1997, the USACE assumed responsibility for the administration and execution of FUSRAP pursuant to the Energy and Water Development Appropriations Act of 1998 (Public Law 105-62). Subsequently, the 2000 Energy and Water Development Appropriations Act (Public Law 106-60) established the legislative authority of the USACE to conduct response actions for releases related to the nation's early atomic energy program subject to the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

At that time, USACE identified six potentially impacted areas, referred to as Areas of Concern (AOCs), based on earlier DOE investigations and its own preliminary evaluations. To facilitate further investigations and remedial decisions, the USACE organized the six AOCs into three OUs, based primarily on the nature of past MED activities in each area. The locations of the FUSRAP OUs are shown in Figure 1-2. USACE performed separate investigations at each of the following OUs between 2002 and 2007, the results of which are the subject of this Sitewide RI:

- OU 1: Former Building 845 (AOC 1) and F Corral (AOC 2) - These AOCs were production areas where uranium refinement processes occurred.

- OU 2: Central Drainage Ditch (CDD) (AOC 3) and the J-26 Area (former location of Building J-16) (AOC 5) - These AOCs include the location of a former laboratory building (J-16) and drainage ditches through which processing wastes were discharged (CDD).
- OU 3: Historical Lagoon A (AOC 4) and the East Area (AOC 6) - These AOCs were disposal areas for building rubble, discarded equipment, and process wastes.

Pursuant to CERCLA the USACE is proceeding through the remedial action process to determine the most appropriate response at the three FUSRAP OUs (six AOCs) located on the Chambers Works property. The CERCLA remedial action process includes the following steps:

- Preliminary Assessment/Site Inspection (Historical Site Assessment)
- Remedial Investigation/Feasibility Study (RI/FS)
- Proposed Remedial Action Plan and Record of Decision
- Remedial Design and Remedial Action

In accordance with CERCLA, the RI is designed to determine the nature and extent of site contamination, evaluate fate and transport of contaminants, assess current and future risks to human health and the environment posed by existing site contamination, and develop remedial action objectives. With that information, remedial action alternatives are then identified and evaluated during the FS. USACE then prepares a Proposed Remedial Action Plan for public review which details evaluated alternatives and recommends a preferred alternative. After the public review and comment period a Record of Decision is prepared. The USACE has decided to prepare one Sitewide Record of Decision for OUs 1, 2, and 3 at the Chambers Works site.

Distinct from the FUSRAP investigations DuPont is conducting Resource Conservation and Recovery Act (RCRA) corrective actions at the site, in accordance with its Hazardous and Solid Waste Amendments (HSWA) permit issued by the U.S. Environmental Protection Agency (USEPA). The HSWA permit and an agreement between the New Jersey Department of Environmental Protection (NJDEP) and DuPont set forth the necessary corrective actions to address contamination related to DuPont's chemical production activities at Chambers Works. Currently DuPont has identified and is in the process of evaluating more than 60 Solid Waste Management Units (SWMUs) located on the Chambers Works and Carneys Point properties under the RCRA program. For reporting purposes DuPont grouped the six known areas of MED

activity, referred to as AOCs under FUSRAP, into SWMU 33. It is important to note that this is a designation only used by DuPont and that the USACE does not use or recognize the SWMU 33 designation. Presently DuPont is not conducting any RCRA corrective actions in these areas. After FUSRAP remedial actions are completed, any non-MED-related constituents will be the responsibility of DuPont and addressed under its corrective action program.

1.1 Purpose of Report

The purpose of this document is to characterize the nature and extent of contamination in various environmental media (soil, sediment, surface water, and groundwater) that may have resulted from previous MED-related operations at OUs 1, 2 and 3. The USACE's investigations began in 1998 after FUSRAP was transferred from DOE to USACE. Initial activities performed included a detailed records review including interpretation of aerial photographs dating back to pre-MED time period (early 1940s). URS-Dames & Moore completed the draft Phase I Records Review Report in July 2000. Based on the results of the Technical Planning Process (TPP) meeting held in October 2000 the Phase I document was updated (Weston, 2001). Intrusive investigations were then conducted in a phased approach at the three OUs between 2002 and 2007. Investigations for the three OUs were planned and executed in accordance with a set of approved project work management and field sampling plans relative to each OU (Weston 2002a-b; Weston/CABRERA 2002a-b; CABRERA 2003a-e; CABRERA 2004a-c; CABRERA 2005a-b; CABRERA 2006a-b). The results of these investigations including a sitewide groundwater investigation have been compiled and presented in this Sitewide RI report.

A Baseline Risk Assessment (BRA) including both Human Health and Ecological Risk Assessments was performed in support of this Sitewide RI and is presented as a separate companion volume to this report.

1.2 Scope of Investigation

The Sitewide RI for the DuPont Chambers Works FUSRAP site consisted of a phased, multi media environmental investigation of soil, groundwater, surface water, and sediment for the three OUs (OUs 1, 2 and 3). The scope of the FUSRAP investigation and potential response is defined by the USACE document ER 200-1-4: Environmental Quality – Formerly Utilized Sites Remedial Action Program FUSRAP – Site Designation, Remediation Scope, and Recovering Costs (USACE, 2003) and constrained by geographic area and eligible contaminants. The scope

of the geographic area eligible under FUSRAP generally is defined as any area used for activities in support of the nation's early atomic energy program. The scope of specific contaminants eligible for cleanup under FUSRAP is discussed in Section 1.7 and further detailed in the *Technical Memorandum, USACE Determination of Eligible Contaminants for FUSRAP Investigation at DuPont Chambers Works Site* (CABRERA 2011a). The eligibilty of contaminants for FUSRAP cleanup is described in ER 200-1-4. USACE examined historical process and site-specific records to identify radionuclides and chemicals that may have been used in the MED uranium refinement processes at Chambers Works. As a result USACE determined that five radionuclides are eligible for FUSRAP investigation and response actions. No chemicals were identified as eligible contaminants and therefore, chemical constituents are excluded from the scope of this RI investigation (CABRERA 2011a).

The OU 1 soil field investigation was conducted in 2002 by Weston, while the OU 2 field investigation was conducted in 2003 by CABRERA. Follow-on soil sampling activities were conducted in 2007 to establish the relationship of radium-226 (Ra-226) and thorium-230 (Th-230) concentrations with respect to possible MED uranium concentrations, as well as to provide information regarding the concentrations of non-radiological constituents for characterization of chemical risks as part of the BRA. A groundwater investigation of all OUs where soil is potentially contaminated above the Investigative Screening Value (ISV) was conducted from 2004 to 2007.

Investigations at OU 3 were conducted in a phased approach from 2004 to 2006. Initially a supplemental records and aerial photographic review, specific to OU 3, was conducted in order to evaluate potential MED contamination in known and suspected disposal areas (CABRERA 2006c). Information gathered during the supplemental Historical Site Assessment was used to identify Areas of Interest (AOIs) within OU 3 that required further investigation and to plan field sampling activities. A Phase I OU 3 soil investigation was conducted in 2004. The purpose of this investigation was to determine shallow geology, assess health and safety considerations in known disposal areas, and collect necessary data for the design of additional intrusive investigations, if warranted. Based upon analysis of the initial soil investigation results, a more detailed sampling effort was initiated to further delineate the extent of possible uranium

contamination above the ISV in OU 3. Follow-on soil sampling for this OU was also conducted in 2007 for the same purposes as discussed above.

Groundwater impacts, or the potential for groundwater impacts, were confirmed in each OU during the initial investigations. As a result, the USACE decided to further investigate groundwater quality and hydrogeologic conditions using a phased technical approach. The initial groundwater investigation was designed to further investigate confirmed areas of groundwater impact at OUs 1 and 2 and evaluate the potential mobility of aqueous phase uranium in groundwater in these areas. The subsequent groundwater investigation evaluated the horizontal and vertical extent of uranium in groundwater at selected locations in OU 3 and collected additional groundwater data in OU 1. Additional field activities were then completed in Spring 2006 targeting specific data collection needs in OU 3. Quarterly groundwater monitoring sampling events were conducted as part of the overall groundwater investigation from July 2005 through May 2007.

A brief description of the RI investigations for each OU is presented below. Figure 1-2 presents the location of each OU and respective AOCs within the Chambers Works site. The project goals are presented in Table 1-1.

1.2.1 Operable Unit 1

Operable Unit 1 consists of two Areas of Concern; AOC 1, Former Building 845 and AOC 2, F Parking Corral. These AOCs were MED production areas where uranium refinement processes occurred. A detailed description of the location and operational history of the AOCs for OU1 is presented in subsection 1.5.1. Approximately 117 soil samples were obtained from this OU, while 55 groundwater samples were obtained from temporary piezometers under the initial OU 1 investigation. In addition, seven building slab concrete samples were obtained and a total of 27 test pits were completed to further delineate subsurface contamination. The subsequent groundwater investigation resulted in 26 monitoring wells being installed and sampled. Air monitoring to ensure the health and safety of workers and employees was performed during all intrusive sampling activities.

1.2.2 Operable Unit 2

Operable Unit 2 consists of two Areas of Concern; AOC 3, CDD and AOC 5, Building J-26 Area (location of former Building J-16). These AOCs include the CDD through which processing wastes from AOC 1 were discharged and the location of a former laboratory building (Building J-16) and nearby drainage ditches. A detailed description of the location and operational history of the AOCs for OU 2 is presented in subsection 1.5.2. Approximately 230 soil and 30 sediment samples were obtained from this OU. Thirty-three groundwater samples were obtained from temporary piezometers under the initial OU 2 investigation. The subsequent groundwater investigation resulted in two monitoring wells being installed and sampled in AOC 3 while existing DuPont wells were sampled in AOC 5. Air monitoring to ensure the health and safety of workers and employees was performed during all intrusive sampling activities

1.2.3 Operable Unit 3

Operable Unit 3 consists of two Areas of Concern; AOC 4, Historical Lagoon Area A and AOC 6, East Area. These AOCs were disposal areas for building rubble, discarded equipment, and process wastes. A detailed description of the location and operational history of the AOCs for OU 3 is presented in subsection 1.5.3. Approximately 140 soil samples and 13 sediment samples were obtained and analyzed for radiological and chemical parameters from this OU. The groundwater investigation resulted in 12 monitoring wells being installed and sampled. In addition, three DuPont wells were sampled in AOC 4. Air monitoring to ensure the health and safety of workers and employees was performed during all intrusive sampling activities

1.3 Regulatory Framework for Chambers Works FUSRAP Site

Under FUSRAP, and in accordance with CERCLA, the USACE is responsible for implementation of the RI/FS for Chambers Works. The NJDEP and USEPA provide State and Federal oversight for the RI activities, as well as for the RCRA corrective actions being implemented separately by DuPont.

1.4 Chamber Works Background Information

The 1,455-acre DuPont Chambers Works Complex, consisting of the 700-acre Chambers Works manufacturing area and former Carneys Point Works, is located along the eastern shore of the Delaware River in Deepwater, NJ. Figure 1-1 shows the location of the complex extending approximately 2.7 miles between Helms Cove to the north and the Salem Canal to the south.

Henby Creek separates the active Chambers Works manufacturing area from the former Carneys Point Works (now primarily a wildflife habitat area). The Pennsylvania and Reading Seashore Line railroad track bounds the complex to the east.

The Chambers Works Complex is located in a moderately populated area consisting of light to heavy industry, recreational areas, community service areas, and residential neighborhoods. Situated south of the Chambers Works Complex is the Atlantic Electric Power Plant. East of the Chambers Works Complex are light industrial, residential, and recreational areas. North of the complex are community service and residential areas of Carneys Point Township.

1.4.1 Site History

The Chambers Works Complex traces its origins to 1892, when the Carneys Point smokeless gunpowder plant was constructed at the northern end of Carneys Point. By 1914, manufacturing operations had extended south into the Chambers Works area. In 1917, dye and specialty chemical manufacturing began at Chambers Works. Freon and tetraethyl lead (TEL) production began in the 1920s, followed by aromatic chemical manufacturing in the 1940s. By the 1960s, Chambers Works began elastomer production. As chemical manufacturing areas expanded, low-lying areas were filled in with river dredge spoils and other solids to form a foundation for further development. By the late 1970s and early 1980s, the explosives and dye manufacturing divisions were shut down, leaving only chemical manufacturing. Most of the Carneys Point buildings were razed by 1979, leaving behind only building foundations. The only current active waste handling area on the Carneys Point property is the RCRA-permitted secure landfill (known as the C Landfill) north of Henby Creek and the wastewater treatment plant (WWTP). An electric cogeneration facility is located east of the WWTP.

1.4.1.1 Chemical Manufacturing History

The following section has been summarized from the Final Technical Project Planning Meeting Brief, Phase I Records Review (Weston, 2001). The manufacturing areas at Chambers Works currently include the following process areas:

- Organic intermediates and aromatics;
- Petroleum chemicals;
- Fluorochemicals;

- Polymers and elastomers;
- Specialty chemicals.

Historically, the Chambers Works Complex, which includes the Carney Point Works, has been involved in the development of over 1,200 chemical products. The following is a list of some of the major manufacturing areas, past and present, and some of their associated process chemicals and wastes:

Carneys Point Works

This plant operated from 1892 to 1979 and produced nitrocellulose and gunpowder. The materials involved in this production included ether, amines, plasticizers, nitrotoluenes, nitroglycerine salts, nitric acid, and sulfuric acid. Off-quality nitrocellulose was the primary waste from this area.

Chambers Works Manufacturing Area

Dye production operated between 1917 and 1979, producing approximately 700 different dyes. This manufacturing division consisted of the following seven areas, each producing process sludges and nitrobenzene wastes:

- *Azo Colors* - This manufacturing division used organic mercury, amino constituents, benzene, phenols, acids, aniline, toluene, toluidine, sunr, and naphthalene.
- *Basic Colors* - Chemically, the products for this manufacturing division included primarily basic and acid dyes of the triarylmethane series and azine series.
- *Sulfur Colors* - This manufacturing division used sulfur and sodium sulfides; sunr black was the first dye produced at Chambers Works, starting in 1917.
- *Ponsol* - This manufacturing division used sodium hydroxide, sodium hydrosulfide, aluminum chloride, and sulfuric acid.
- *Monastral Colors* - This manufacturing division used blue and green pigments. The manufacturing operations were a section of the Ponsol area organization and used the same chemicals.
- *White Products* - This manufacturing division used alcohols, phosphoric anhydride, alkyl phosphates, sodium dioxide, chloride dioxide, amines, and sulfonyl chlorides.
- *Miscellaneous Intermediates* - This manufacturing division involved the use of aromatic hydrocarbons, chlorinated aromatics, polymers, elastomers, fibers, and anilines.

Chambers Works Indigo Heavy Chemicals Area

This area began operation in 1917, producing indigo dye, sulfuric acid, and chlorine. Other chemicals associated with this area included sodium hydroxide, hydrochloric acid, ammonia, sodium, sulfur, benzene, nitrobenzene, nitrotoluene, chlorobenzene, methylamines, and ethyl chloride.

Chambers Works Fluorochemicals Production Area

This area produced Freon® products. It began operation in the 1920s and manufactured fluorinated hydrocarbons from hydrofluoric acid, sulfuric acid, hydrochloric acid, carbon tetrachloride, fluorspar, antimony pentachloride catalyst, and perchloroethylene. DuPont has phased out chlorofluorocarbon production and replaced it with the SUVA® refrigerant product line, which includes hydrochlorofluorocarbons and hydrofluorocarbons.

Chambers Works Motor Fuel Antiknock Production Area

This area produced motor fuel antiknock compound, which contained TEL and tetramethyl lead from sodium, ethylene, methanol, methyl chloride, and ethyl chloride. The lead alkyls are the primary waste from this area. TEL production began in the 1920s and was discontinued in the spring of 1991.

Chambers Works Petroleum Chemicals

This manufacturing area produces oil additives. Organic amines and methacrylate polymers are used in this area.

Chambers Works Polymer Products Manufacturing Area

This area produces Hylene, Hytrel plastics, and Viton elastomers using organic isocyanates, phosgene, dinitrotoluene, and hydrochloric acid.

Chambers Works Aromatics and Specialty Chemicals

This manufacturing area began production in the 1940s and is still one of the primary manufacturing areas. Materials involved in this area include petroleum hydrocarbons, acids, solvents, inorganic constituents, and aromatic hydrocarbons.

Chambers Works has been impacted by a number of constituent releases associated with its historical chemical operations. Chambers Works is a RCRA-regulated facility and is currently conducting a RCRA Facility Investigation (RFI) and sitewide groundwater remedial action. As discussed earlier in this report, DuPont designates the FUSRAP areas where MED activities occurred (OU 1, 2, and 3) as SWMU 33. The Fluorochemicals Area (more precisely the Kinetic Chemicals Area) was the site of DuPont's hydrofluoric acid production. Calcium sulfate sludge (i.e., gyp cake) waste from this process was disposed of in an area directly north of AOC 3.

1.4.1.2 Former Manhattan Engineer District History

Operations involving uranium at the site began in 1942. MED contracted with DuPont to perform several uranium-processing activities in support of the nation's early atomic energy program. In 1946 all MED activities were transferred to the AEC, and DuPont continued its research until late 1947. DuPont's contracts with MED and later with AEC involved the following uranium refining processes which were performed in an area known as the "Blue Products Area" located in OU 1:

- Recovery process (AOC 1, Building 845)
- Brown oxide process (AOC 2, Building 708)
- Green salt process (AOC 2, Building 708)
- Metal process (AOC 2, Building 708)

In addition, Chambers Works converted quantities of green salt (uranium tetrafluoride) to uranium hexafluoride. This processing, known as the hexafluoride process, was performed at the former Building J-16, now the Building J-26 Area (OU 2). Pilot-scale work on the brown oxide, green salt, and recovery processes also took place in the former Building J-16.

DOE has estimated that more than half of the MED-related material produced at Chambers Works came from uranium peroxide dihydrate which was obtained by processing uranium-bearing scrap material (USDOE, 1997). Other research involving radioactive materials was also performed onsite but there was no enriched or depleted uranium used at the site.

The ore concentrate refining process was not conducted at Chambers Works. Ore concentrates have historically contained the contaminants thorium and radium due to incomplete separation

from uranium ore. The documented processes conducted on a laboratory and/or production level at the Chambers Works were performed under the MED contracts and projects listed in Table 1-2. Those projects involving uranium are also outlined on Figure 1-3.

1.5 Description of Operable Units and Areas of Concern

1.5.1 Operable Unit 1

Operable Unit 1 consists of the following two Areas of Concern: AOC 1, Former Building 845 and AOC 2, F Parking Corral. The following subsections describe each of these AOCs, including the location and history of operations and disposal activities. These operational activities have resulted in potential source areas of MED contamination for each of the AOCs. The location of AOCs 1 and 2 are shown in Figure 1-2. Figure 1-4 presents a layout of the primary structures associated with both AOCs in relation to the historic and present location of the CDD (part of OU 2) and the historical extent of the lagoon area (Basin Complex).

1.5.1.1 Area of Concern 1, Former Building 845 Area

The site of the Former Building 845 is located in the northwest quadrant of the Chambers Works portion of the facility, just to the east of the F Parking Corral Area. The general site layout of AOC 1 is shown on Figure 1-5.

DuPont Project 9803, under contract W-7412-Eng. 22, was housed in Buildings 101 and 102. Building 845 contained the Former Buildings 101 and 102. Work in these buildings included recovering uranium from scrap materials and by-products of other uranium processes performed in the MED complex, and research and development for the design of the conversion process. Production began in August 1943. During processing, 5,486 tons of scrap material was converted to 982 tons of black oxide through January 1947. Residual wastes from processing in Buildings 101 and 102 were thought to have been discharged into a wooden trough located east of the building. Process wastewaters and material were transported via the wooden trough to the CDD approximately 150 feet (ft) north of the buildings. The CDD then carried the material to the western corner of Historical Lagoon A (see Figure 1-4). Stormwater from the CDD is currently collected in Basin B. The wooden trough is still in existence, and currently collects stormwater that then discharges to the CDD.

Following completion of the project, equipment from Building 845 was removed and either buried in the East Burial Area or sent to the Niagara Falls Storage Site within the Former Lake Ontario Ordnance Works. In 1948, the building was surveyed by the AEC. Following an AEC decontamination effort, the building was released to DuPont. Subsequently, Oak Ridge National Laboratory (ORNL) in 1977, and Bechtel National, Inc. (BNI) in 1983, surveyed the building. Additional decontamination operations were conducted inside the building in 1996. The building was demolished in September 1999. Building debris and rubble were separated from structural steel components. The debris and rubble were cleared for onsite disposal in the Chambers Works Sanitary Landfill. The structural steel was removed from the site by USACE and disposed of in an approved facility in Texas in November 1999.

The building slab remained and was covered with 12 to 18 inches of stone to cover cracks in the concrete. The slab thickness varies from six to eight inches for the building floor and three to four ft at footing/bearing wall and former tank locations. The elevator shaft was filled with sand and construction rubble/debris. The wooden trough was not remediated as part of this effort.

1.5.1.2 Area of Concern 2, F Corral

The F Parking Corral lot is located immediately west of Former Building 845. The general site layout is shown on Figure 1-6. This parking lot is the former location of Building 708, which was used for the production of uranium metal. Building 708 was demolished in 1953, along with approximately 1,000 cubic yards (yd^3) of underlying earth, and disposed of in the Historical Lagoon A area. The building was also identified as the larger of the buildings in the F Parking Corral. The identification, however, was reevaluated based upon the inconsistencies of the historical aerial photographs and further historical documentation review. The reevaluation is discussed below.

The Bechtel Interoffice Memorandum (BNI, 1997) presents a discussion of the buildings associated with each contract and the location of these buildings. The original figure is presented in the Interoffice Memorandum, and has been revised with more legible text for use in this RI report. Figure 1-7, the revised figure, shows clearly that Building 708 was a smaller rectangular building in the northeast corner of the F Parking Corral. In addition, the Bechtel figures (BNI, 1997 Figures 1-27 and 1-28) presenting the results of Bechtel's investigation clearly identify

Building 708 in the northeast corner of F Parking Corral. The grid system presented in these BNI figures is consistent with the DuPont facility mapping coordinates.

Building 708 occupied a portion of the present F Parking Corral Area. Building 708 housed operations for DuPont Project 9634, under contract W-7412-Eng. 3. Under this contract, DuPont converted sodium uranate, commercial black oxide, and uranium peroxide dihydrate to brown oxide. The brown oxide was then converted to green salt, which was in turn converted into uranium metal. The green salt was produced at a rate of 47 tons per month. Production began in April 1943. A total of 1,970 tons of brown oxide were produced through May 1946. When green salt and metal production were suspended in the summer of 1944, 608 tons of green salt and 232 tons of uranium metal had been produced. In 1945, part of Building 708 was demolished and removed from the site as reported in the TPP Phase I document (Weston, 2001). In 1953, the remainder of the building and some underlying soil were removed and may have been disposed of in Historical Lagoon A as reported in the TPP Phase I document. The building is present in the aerial photographs up until 1954, which conflicts with the reported 1953 removal of Building 708. The building is no longer present in the 1959 photograph, indicating the building was removed in the years between 1954 and 1959.

1.5.2 Operable Unit 2

Operable Unit 2 consists of the following two Areas of Concern: AOC 3, CDD, and AOC 5, Building J-16. The following sections describe each of these AOCs, including location and history of operations and disposal activities. These operational activities have resulted in potential source areas of MED contamination for each of the AOCs. The location of both AOCs 3 and 5 within Chambers Works is shown in Figure 1-2. An aerial view of the site layout for AOC 3 and AOC 5 is shown in Figures 1-8 and 1-9, respectively.

1.5.2.1 Area of Concern 3, Central Drainage Ditch

The CDD is a component of the Historic Process Water Ditch System (HPWDS). The CDD received process waste from Buildings 708, 101 and 102 (Building 845). This wastewater was transferred to Historical Lagoon A (now part of OU 3). As part of DuPont's RCRA remedial action program for the Chambers Works site, the HPWDS is in the process of being remediated. The CDD component was remediated in 1997 to remove lead-contaminated soil and DuPont disposed of the material in an on-site vault located in the closed former A settling basin. Soil

samples were collected by DuPont for USACE before and after the remediation to evaluate the potential for any residual radiological contamination.

1.5.2.2 Area of Concern 5, Building J-26 Area (Former Building J-16)

Building J-16 housed the Jackson Laboratories. These laboratories performed experimental work, including designing and refining chemical and radioactive production processes. Products included green salt (UF_4) and the gas, uranium hexafluoride (UF_6). The laboratory served as a unit operations test facility for the uranium oxide to uranium tetrafluoride (brown oxide to green salt) conversion process. The drain from Building J-16 may have emptied into the ditch by Semi-Works Road. The building was expanded sometime between 1943 and 1944, creating potentially 200 tons of contaminated debris. Several feet of earth were removed as part of the expansion. The debris and earth were placed in a berm along Historical Lagoon A (OU 3). A larger building, J-26, is now located over the former Building J-16 footprint. No process quantities are reported, but the amounts are likely small, consistent with laboratory and pilot scale operations.

1.5.3 Operable Unit 3

Operable Unit 3 consists of the following two Areas of Concern: AOC 4, Historical Lagoon A and AOC 6, East Area including the former East Burial Area. The location of both AOCs 4 and 6 are shown in Figure 1-2. The following sections describe each of these AOCs, including location and history of MED operations and disposal activities. These operational activities may have resulted in potential areas of MED contamination for each of the AOCs. The location of both AOCs 4 and 6 and their respective AOIs are shown in Figures 1-10 and 1-11, respectively. AOIs were identified based on previous investigations and historical document and aerial photographic reviews to identify areas of possible MED disposal activities. AOC boundaries include the AOIs and reflect the extent of the FUSRAP investigation.

1.5.3.1 Area of Concern 4, Historical Lagoon A

Historical Lagoon A was located in the northern portion of the site, bounded by the Delaware River to the north, Plant No. 1 Road to the south, Kinetic Road to the west, and Boundary Road to the east. Historical Lagoon A was later separated into three settling basins; Settling Basins A, B, and C. The number and size of these basins varied significantly over time during the operation of the plant. Historically, Lagoon A received wastewater from Chambers Works

manufacturing areas, including that generated by MED operations. The CDD provided the conduit for this wastewater from the MED operational areas to be discharged to the lagoon. As the lagoon was filled in over time it is reported that building debris and potentially contaminated soil from MED operational buildings may have been disposed of in AOC 4 (CABRERA 2006c). This AOC includes the area referred to as the North Burial Area or DuPont's SWMU 5.

AOC 4 was used for the management of chemical process wastes prior to the commencement of MED activities at Chambers Works. In the early 1920s, a lagoon was formed by the installation of a sluiced dam at the mouth of Whopping John Creek to form a 50 acre impoundment basin on the swampy ground between Chambers Works and Carneys Point Works. The lagoon was used as a settling basin for process wastewater. DuPont added quick lime and lime waste runoff to reduce the acidity of the wastewater before discharging it to the Delaware River. Extensive land filling activities occurred around the lagoon in the 1930s and 1940s. Air photos from 1940 and 1942 show fill areas on all sides of the lagoon (EA, 2003).

After MED activities began at Chambers Works, AOC 4 was modified as discussed below to facilitate the management of MED-related wastes. During the MED era, the lagoon consisted of the impounded basin (about 50 acres) on marsh land between the Dye Works and Carneys Point Works. The Process Water Ditch System carried liquid wastes from the operations units into the basin, where solids were allowed to settle before the liquids were sluiced into the river. By-product waste lime run-off from the neoprene operation was disposed into a ditch near the basin to help neutralize the acidity of the waste waters (DuPont, 1984).

No uranium-production activities took place in the Lagoon Area. Wastewater from MED operations in the Blue Products area (OU 1) and the East Area (OU 3) was directed through the Process Water Ditch System to the lagoon (Weston, 2001). Presumably, waste liquors from filtration processes were directed to the Process Water Ditch System and entered the lagoon.

A review of historical aerial photographs of AOC 4 indicates that the lagoon complex was gradually filled in from all sides using wastes and building debris after MED activities ceased at Chambers Works. Historical records indicate that in 1948 Building 708 (located in OU 1) was decommissioned. In 1953, the building was removed along with several feet of underlying earth

and the building debris was reportedly disposed of in the Lagoon A area (BNI, 1985). At the northern end of the lagoon, the location of the outlet channel leading to the Delaware River was changed over the course of time. The area along the river's edge, which had been marshland in the 1940s, began to be used as a landfill area for waste and debris. This area is now known as SWMU 5.

During Neoprene operations, the lagoon was used as a settling basin for process wastewater. DuPont added quick lime and lime waste runoff to reduce the acidity of the wastewater before discharging it to the Delaware River. A 78 inch wood stave line was added in 1958 to pump treated wastewater directly into the river. The continual addition of lime to the effluent waste eventually filled the basin with unreacted lime and reaction products. In September 1951, it became necessary to dredge the basin for the first time. The solids were removed from the basin by a hydraulic dredge and may have been deposited along the northern boundary of Chambers Works (see Power Division History, p.64 in DuPont, 1984).

1.5.3.2 Area of Concern 6, East Area

The East Area was used to manufacture fluorinated hydrocarbons and fluorolube under contract with MED. The East Area includes the East Burial Area, which also received demolition debris and discarded equipment from MED projects conducted in the Blue Products area of Chambers Works. This burial area was located adjacent to and north of East Road.

AOC 6 was used for management of chemical process wastes prior to the commencement of MED activities at Chambers Works. Historical aerial photographs indicate that the East Area was used as a landfill beginning about 1940 (CABRERA 2006c). The MED Construction Completion Report indicated that the site, originally swampland, had been backfilled with chemical refuse and used as a landfill prior to MED use. During MED construction activities it was necessary to remove the refuse to a depth of about three ft and then cover the area with earth fill to provide earthen cover (USACE, 1946).

After MED activities began at Chambers Works, AOC 6 was modified to facilitate the management of MED-related wastes. During the MED operations, AOC 6 was known as the East Area. MED contracted DuPont to construct a 30 building complex on 21 acres of DuPont-

owned land in the East Area (BNI, 1985). The aerial photograph in Figure 1-12 shows MED operations in the East Area in 1944. The area extended into a refuse swamp and required 35,000 yd^3 of backfill to make it suitable for construction. In the complex that was built DuPont produced fluorinated solvents and fluorinated lubricants under contract to MED. Uranium processing did not take place in the East Area.

DuPont purchased the buildings of the East Area from the U.S. government in 1949. Following the war, some buildings in this area were dismantled while others were converted for DuPont's industrial use by the Petroleum Laboratory, the Technical Laboratory Annex, "Ponsol" Colors Stores, and the Industrial Hygiene Laboratory (DuPont, 1984). When the equipment from Building 845 in OU 1 was removed, it was either buried in the East Burial Area or sent to the Lake Ontario Ordnance Works in Lewiston, NY for disposal (BNI, 1985).

The Industrial Hygiene Laboratory developed several new programs in 1955, one involving the use and handling of radioisotopes by DuPont. Radium and radioactive isotopes were used as technical tools in procedures such as making density and liquid-level measurements, tracing molecular actions, and testing substances (Safety Department History in DuPont, 1984). These post-MED programs were unrelated to any government contracts associated with MED uranium refinement in the 1940s.

DuPont used the East Burial Area for disposal of its radioactive waste on three occasions in 1964, 1969, and 1970. DuPont was permitted by the State of NJ for the disposal of these wastes. Two letters were cited from the NJDEP permitting disposal of Carbon-14 in drums within a previously delineated burial site located within Chambers Works (Weston, 2001). It was also reported that DuPont buried radioactive material in two small areas of Landfill A (NJDEP, 1988). In addition, various chemical wastes and small amounts of NJ approved low-level radioactive material were reported to have been stored in the East Burial Area (BNI, 1985), presently located under East Road.

Weston (2001) refers to the disposal of 7.42 pounds of thorium dioxide (TD) nickel in this area under permit from the NJ Department of Health in a letter dated April 16, 1964. TD nickel is a

nickel alloy containing 2% thorium dioxide and is most often used as cladding material for Cobalt-60.

1.5.4 Background Reference Area

USACE identified a background reference area southwest of AOC 6 to characterize the background concentrations of naturally occurring radionuclides and naturally occurring metals present in soil and groundwater on the Chambers Works property. The selected area has the same basic characteristics as the Site sampling locations but was not the site of any MED production activities or releases of MED wastes or materials. This background reference area is shown on Figure 1-2. Although not an FUSRAP Area of Concern sample station locations within this area were designated as AOC 7 during the field program. Results of the sampling for the background reference area are presented in Section 9.0 of this report and are being used in the human health and ecological risk assessments.

1.6 Previous Investigations

1.6.1 Atomic Energy Commission/Department of Energy

In 1948 and 1949, AEC conducted radiological surveys and decontamination of building surfaces at the site. Following a radiological survey based on criteria existing at the time, AEC released the buildings back to DuPont in 1949. DuPont demolished Building J-16 after it was released by AEC and excavated several feet of soil from beneath the building (USDOE, 1996). Building J-26 was subsequently constructed over the Building J-16 footprint.

1.6.2 Oak Ridge National Laboratory 1977

Oak Ridge National Laboratory (ORNL) conducted a radiation survey of the Chambers Works site in 1977 (ORNL, 1978). Survey results are available for several of the AOCs described in this RI and are summarized below.

The results of the survey in the F Parking Corral Area (AOC 2) indicated exposure rates of four to five microRoentgens per hour (µR/hr). This exposure rate is consistent with background radiation levels. Two soil borings were obtained in the F Parking Corral Area, along with one water sample. Uranium-238 (U-238) results were reported as non-detect to 6.8 picoCuries per gram (pCi/g) in the soil samples and 1.8 picoCuries per liter (pCi/L) in the water sample.

External gamma radiation levels along the CDD (AOC 3) indicated exposure rates of three to 23 µR/hr. This exposure rate range exceeded background radiation levels. Five soil borings were taken along the drainage ditch and a water sample was collected from one of the boreholes which yielded 0.67 pCi/L for U-238.

In the East Area (AOC 6), external gamma radiation levels indicated an exposure rate of 12.2 to 15 µR/hr, which exceeded the background radiation level of 4.5 µR/hr. Ten soil borings were performed along the East Area drainage ditch. Water samples collected from two soil borings yielded total uranium concentrations between nine micrograms per liter (µg/L) and 36 µg/L.

1.6.3 Bechtel National, Inc. 1983

BNI also performed a radiation survey of the Chambers Works site in 1983 (BNI, 1985). Survey results available for several of the AOCs described in this RI are summarized below.

In the F Parking Corral (AOC 2), near-surface gamma radiation measurements performed using a sodium iodide (NaI) detector were generally less than twice background, with a maximum of 5,020 counts per minute (cpm) compared to a background of 4.5 µR/hr (ORNL background value). External gamma radiation, as measured by a pressurized ionized chamber yielded dose rates ranging from 11.6 to 13.8 µR/hr. Nineteen boreholes were drilled in the F Parking Corral Area. Based on gamma logs, subsurface contamination was indicated in layers to a depth greater than nine ft. Results from two Shelby tube soil samples indicated that U-238 was the major contaminant with concentrations ranging from 0.90 to 4,380 pCi/g. Eleven water samples were also collected from the boreholes, with total uranium concentrations ranging from 1.8 to 105,105 pCi/L.

Near-surface gamma radiation measurements performed in the CDD (AOC 3) indicated surface activities that were elevated above background (a maximum of 14,532 cpm compared to a background of 2,500 cpm). External gamma radiation yielded dose rates ranging from 13 to 15 µR/hr, with a background of 4.5 µR/hr. Fifteen sediment samples were collected along the CDD. These samples were taken between zero to six inches bgs in the first six inches of depth. No samples deeper than six inches were collected. No water samples were collected.

1.6.4 DuPont 1988 - Present

DuPont has been in the process of conducting RCRA corrective actions at Chambers Works since 1988. The USEPA Comprehensive Environmental Response, Compensation and Liability Information System identification number for Chambers Works is NJD002385730. The RCRA corrective action program is implemented through a HWSA permit (No. NJ002385730) that was issued by USEPA to Chambers Works on November 7, 1988. Prior to this NJDEP issued an Administrative Consent Order in 1984 and later amended in 1988 requiring DuPont to conduct remedial actions at the A, B, and C Basins and the Process Water Ditch System, (SWMUs 14, 15, 16, and 17, respectively). These areas are shown in Figure 1-13 along with other selected DuPont SWMUs that are located in the general vicinity of the FUSRAP AOCs. This figure with the approximate boundaries of the SWMUs is provided for reference purposes during subsequent discussions. As part of its RCRA investigation, DuPont has designated the areas of former MED activity that are being investigated under FUSRAP as SWMU 33.

In accordance with its permit requirements DuPont operates an extensive sitewide pump and treat system in order to control offsite migration of chemical contaminants in groundwater. Referred to as the Interceptor Well System (IWS) DuPont began operations in 1970. The well locations making up the IWS are also shown in Figure 1-13. The IWS is further described in Section 3, Physical Characteristics.

DuPont submitted an RFI report to NJDEP and USEPA in 1995. In this report, DuPont compared site groundwater quality to NJ Class IIA groundwater standards. These criteria are designated for aquifers that either provide or potentially provide potable water using conventional treatment (NJAC 7:9C). NJDEP has designated Chambers Works as a Classification Exception Area. With this classification the aquifers under Chambers Works are not considered potable sources and are not required to meet the Class IIA standards. DuPont contains and monitors groundwater at Chambers Works according to its permit requirements.

DuPont excavated soils from the CDD where it intersects OU 1 in 1997 as part of a remediation effort for lead isotope contamination. Excavated soils were disposed of in an on-site vault. Post-excavation sampling and analysis was performed by ORNL. Results indicated that ditch

sidewall samples were beneath the cleanup criterion of 150 pCi/g U-238 (above background). These results were for concentrations averaged over areas of 100 square meters (m^2).

1.7 Description of Constituents of Potential Concern

As mentioned earlier the USACE is authorized to conduct response actions for releases related to the nation's early atomic energy program. The following types of hazardous substances are considered eligible contaminants and within the scope of FUSRAP investigations and cleanup activities:

- Radioactive contamination (primarily uranium, thorium and associated radionuclides) resulting from activities performed for the MED or AEC, to include hazardous substances associated with these activities (e.g., chemical separation, purification);
- Other radioactive contamination or hazardous substances that are mixed or commingled with MED or early AEC radioactive contamination;
- At federally-owned FUSRAP sites, all radioactive contamination and hazardous substances are within the scope of the FUSRAP response action; and
- Other substances where specifically directed by Congress (USACE, 2003).

To determine the FUSRAP-eligible contaminants at Chambers Works, the USACE reviewed historical site records, the use of specific compounds and feedstock materials at the Site, and general industry references describing similar processes at other facilities. After listing all radiological and chemical constituents listed in MED documents, the USACE utilized a screening process to identify those radiological and chemical constituents that may be eligible for investigation and cleanup under FUSRAP. As a result of the screening process five radionuclides and no hazardous substances or chemicals were determined to be eligible contaminants (CABRERA 2011a). The eligible contaminants are further discussed below.

1.7.1 Radiological Contaminants

Earlier site investigations concluded that MED-related radiological contamination is limited to isotopes of refined uranium (i.e., U-234, U-235, and U-238) and their short-lived decay progeny (Weston 2004). The term "refined" in this context refers to uranium with uranium isotopes in isotopic equilibrium but with non-uranium daughters either substantially reduced or removed.

Refined natural uranium, initially identified as the primary site contaminant, is in a state of secular equilibrium with its short-lived decay progeny, which consist of daughter radionuclides with half-lives short enough to allow them to decay at the same rate at which they are produced. Based on the assumption that the original uranium refinement processes were performed approximately 60 years ago, only the short-lived uranium decay progeny and the three parent isotopes (U-234, U-235 and U-238) would be expected to be present today in significant quantities. These radionuclides include:

- U-238 short-lived decay progeny Thorium-234 (Th-234) (24-day half-life) and Protactinium-234 Isomer (Pa-234m) (1.17-minute half-life);
- U-235 short-lived decay progeny Thorium-231 (Th-231) (25-hour half-life); and
- U-234 has insignificant decay progeny that are expected to be present.

Long-lived thorium isotopes have been identified as radionuclides of potential concern (ROPCs) at other FUSRAP sites where uranium ore or where ore concentrates were used as MED feedstock. The ore concentrate refining process was not used at Chambers Works. However, Black Oxide (sodium uranate) feedstock was used at the site and based on USACE research, small amounts of radium and thorium contamination may be left behind in the feedstock as an impurity during the chemical separation process. The USACE performed a data evaluation by comparing site sampling results of Th-230 with respect to the potential in-growth concentration of Th-230 from its parent products, U-234 and U-238. The results of the data evaluation showed that the Site concentrations for Th-230 are significantly higher than the expected in-growth concentration of Th-230. It is assumed that the excess concentrations of Th-230 are due to the presence of impurities within the sodium uranate feedstock. Therefore, Th-230 was added to the list of ROPCs for Chambers Works. For this reason subsequent RI soil sampling efforts (e.g. OU 3 and the 2007 supplemental sampling program) were sampled for Isotopic Thorium. In addition previously collected and stored OU 1 and OU 2 soil samples were analyzed for Isotopic Thorium.

Radium-226 was also added as an ROPC since it is a daughter product in the decay chain of U-238 and is present in unrefined uranium ore. Like Th-230, a similar data evaluation was performed to compare the potential in-growth concentration of Ra-226 from its parent products,

U-234 and U-238, with the observed Ra-226 concentrations at the Site. The Site concentrations for Ra-226 are again significantly higher than the calculated in-growth concentration of Ra-226. In addition, Ra-226 has been identified as a co-contaminant of uranium at other FUSRAP sites. Therefore, Ra-226 was identified as a potential contaminant in the Black Oxide feedstock and also added to the ROPC list for Chambers Works.

Therefore, five ROPCs have been identified as eligible contaminants for FUSRAP investigation and possible remediation at Chambers Works. They include U-234, U-235, U-238, Th-230, and Ra-226.

1.7.2 Chemical Constituents

Although no chemicals or hazardous substances were identified as eligible contaminants for the Site, USACE collected and analyzed environmental media for non radiological contaminants (i.e., volatile and semi-volatile organics and metals) in order to evaluate health and safety measures and investigative-derived waste (IDW) disposal options. Although these chemical constituents were not identified as Constituents of Potential Concern (COPCs) for the RI, the data was obtained to assist in the characterization of chemical risks as part of the BRA. Target Analyte List (TAL) metals and Target Compound List (TCL) volatile and semi-volatile organic data were obtained to assist in the characterization of chemical risks as part of the BRA. Analytical analyses for metals in groundwater also provided useful information for the interpretation of geochemical conditions at the Site.

1.7.3 Investigative Screening Value

An ISV was initially developed for the RI in order to establish boundaries of MED-related contamination based on the uranium isotopes U-234, U-235 and U-238. These three isotopes were the original ROPCs for the site. This ISV was developed by utilizing the incremental screening values Derived Concentration Guideline Levels (DCGLs) of 10 pCi/g for U-238, 10 pCi/g for U-234, and seven pCi/g for U-235 presented in Table 1A of the New Jersey Administrative Code (NJAC) 7:28-12. These screening values were based on unrestricted use of soils with a vertical extent of nine ft (each individual screening value represents 15 millirem dose to a resident per year). By assuming secular equilibrium between the U-238 parent and its U-234 daughter along with calculated activity fractions of 0.489 U-238, 0.022 U-235, and 0.489 U-234, a composite DCGL of 9.9 pCi/g was derived for total uranium. Since the U-238 isotope was

used as the surrogate for total uranium in the soil, the U-238 portion of the total DCGL for the Site was derived to be 4.8 pCi/g. Finally, by adding the natural background concentrations of U-238 in the soil to this value, the ISV values of seven pCi/g U-238 and 14 pCi/g total uranium were derived for Site use. The modeling approach also included the conservative assumption of residential groundwater use.

An evaluation of the sensitivity of the radiological field instruments and on-site laboratory was also performed and the results concluded that the on-site gamma spectroscopy laboratory provided an acceptable level of sensitivity. Investigative results were compared to the ISV and used to plan additional sampling activities and define the extent of contamination in all OUs.

1.8 Report Organization

This RI report follows the format recommended by USEPA in *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (USEPA, 1988). A baseline human health risk assessment and screening level ecological risk assessment are being performed as part of this sitewide RI report but are presented in a separate, companion volume. This sitewide RI report is organized into the following sections:

Section 1.0 **Introduction** includes the purpose of this report plus a description of the site.

Section 2.0 **Investigation Methods** provides a description of all investigative techniques used during the RI.

Section 3.0 **Physical Characteristics of the Study Area** provides a discussion of site characteristics.

Section 4.0 **Operable Unit 1 Investigation Results** presents the results of the site investigation for OU 1. The section is organized by AOC and each physical media investigated.

Section 5.0 **Operable Unit 2 Investigation Results** presents the results of the site investigation for OU 2. The section is organized by AOC and each physical media investigated.

Section 6.0 **Operable Unit 3 Investigation Results** presents the results of the site investigation for OU 3. The section is organized by AOC and each physical media investigated.

Section 7.0 **Contaminant Fate and Transport** discusses potential routes of migration, the persistence of the contaminants in the environment, and factors affecting any actual contaminant migration.

Section 8.0 Summary and Conclusions presents summaries of the geologic and hydrogeologic conditions at the site, the nature and extent of the contamination, and contaminant fate and transport for each OU.

Section 9.0 Background Reference Area presents the results of the background sampling for each affected media; discusses the statistical methodology used in development of background concentrations; and presents background concentrations for each constituent in each media evaluated.

APPENDICES

Appendix A Ground Penetrating Radar (GPR) Data for soils

Appendix B Gamma Surveys

B-1: Gamma Walkover Surveys

B-2: Gamma Surveys (Downhole & Spectral)

Appendix C Soil Logs & Well Construction Diagrams

C-1: Geoprobe Soil Logs

C-2: Cone Penetrometer Testing (CPT) Soil Logs

C-3: Subsurface Drilling Soil Logs & Well Construction Diagrams

C-4: Test Pit Logs – OU 1

Appendix D Investigation-Derived Waste Analytical Data

Appendix E Air Quality Monitoring & Health/Safety Environmental Monitoring Records

Appendix F Soils Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC)

Appendix G Well Development Records and Water Level Measurement Forms

G-1: Piezometer Records

G-2: Monitoring Well Records

Appendix H Groundwater Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC)

Appendix I Groundwater Elevation Contour Maps (Quarters 1-7)

Appendix J Slug Test Data – OU 1 and 2

Appendix K YSI Calibration Logs

Appendix L Water Quality Data Figures & Isopleths (Quarters 1-7)

Appendix M Quality Assurance/Quality Control Evaluation Results

Appendix N Total Uranium Isopleth Maps (Quarters 1-7)

Appendix O Ecological Site Visits, October 2003 and July 2007

Appendix P Surface Water/ Sediment Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC)

Appendix Q Weather/Transducer Data OU 3

Appendix R Soils Analysis Reports, USACE Waterways Experiment Station

2.0 INVESTIGATION METHODS

This section presents a generalized discussion of sampling strategies, geophysical survey techniques, soil and groundwater investigative methods and analytical methods utilized for the sitewide RI. The specific methods used in each OU are presented with the investigation results in Sections 4.0 (OU 1), 5.0 (OU 2), and 6.0 (OU 3) of this RI Report. A brief summary of strategies and investigative methods used for each OU and for the Background Reference Area is presented in Table 2-1.

2.1 Sampling Strategy

2.1.1 Use of MARSSIM

Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) guidance in Chapter 5, *Survey Planning and Design* (DOD, et al., 2000) was used to develop sampling strategies for the sitewide RI. The sampling was designed to be consistent with characterization surveys and not final status surveys. According to MARSSIM, a characterization survey should clearly identify those portions of the site (*e.g.*, soil, structures, and water) that have been affected by site activities and are potentially contaminated. The survey should also identify the portions of the site that have not been affected by these activities. The survey should provide information on variations in the contaminant distribution in the survey area.

Sample locations for each OU and corresponding AOCs were based on a combination of historical data review, operational history, current and/or previous locations of structures and physical features contained within each AOC.

2.1.2 Systematic Grid and Grid Surveying

Systematic grids were established for each AOC within OU 1. The spatial boundaries of the grid were based on information presented in the URS-Dames & Moore Phase I Records Review Report as updated by WESTON (WESTON, 2001). The horizontal limits of the proposed grid system were defined by the location of the structures identified as being used for MED contracts and the physical boundaries defined by the drainage ditches and railroad spurs surrounding the identified structures.

A triangular grid pattern was established in AOC 1 using a random starting point and 75 ft grid-node spacing. In AOC 2, the same grid pattern was used at the former location of Building 708, while to the south of Former Building 708, the sampling grid used 100 ft spacing. The greater distance between grid nodes was based on historical information, which did not indicate structures associated with MED contracts in this location. Determination of actual grid sampling points was based on geophysical survey data (Section 2.1.5) and physical features of the site.

Once a grid pattern was established, and prior to conducting any intrusive activity, the field team surveyed the sampling locations. The northing and easting coordinates for each location were obtained from the Geographic Information System (GIS) map of each AOC provided by USACE. The x and y coordinates were entered into the differential global positioning system (DGPS) instruments and located and marked in the field. The sample identification number was recorded on all field documentation and x-y coordinates were related to each sample through a GIS database. The sample identification number was recorded on all field documentation and x-y coordinates were related to each sample through the GIS database. Table 2-2 summarizes the selection criteria for the soil boring locations in OU 1 plus the rationale for any changes made to these locations while in the field.

2.1.3 Boring Locations

The USACE selected the original soil boring locations in OU 2, which were placed along the historic centerline of drainage features, spaced either 50 or 75 ft apart (AOCs 3 and 5, respectively). Soil borings within OU 3 were determined based on historical information and review of historical aerial photographs that identified potential areas of buried equipment and debris. The boring locations were supplied in AutoCAD file format and this data was used to locate their positions at the site using a Trimble Pro global positioning system (GPS). The boring locations were marked with spray paint and pre-approved by both the USACE and DuPont before proceeding.

Table 2-3 summarizes the selection criteria for the soil boring locations in OU 2 plus the rationale for any changes made to these locations while in the field. Table 2-4 summarizes the selection criteria for the soil boring locations in OU 3, while Table 2-5 presents selection criteria for the Background Reference Area.

For all samples, a five-digit identification number was assigned to each location. Locations were identified using the AOC number (i.e., 4 or 6), followed by the letters signifying the location type (i.e., "CPT" for cone penetrometer testing or "SB" for soil boring) and the respective location number.

2.1.4 Biased Samples

The results of the gamma walkover surveys (GWS) (Section 2.1.5.5) were evaluated to identify potential biased sample locations for all OUs. Possible biased samples were selected where gamma walkover measurements exceeded three standard deviations above the survey average. If readings were normally distributed, approximately 1% of the readings exceeded the investigative level based on statistics alone. Biased sample locations were also selected based upon the results of previous investigations. Detailed information regarding biased sample locations are provided in the respective sections for each OU.

2.1.5 Geophysical Surveys

Geophysical surveys were conducted to provide a cost-effective means of locating subsurface utilities and other features that could potentially interfere with intrusive soil sampling activities. Survey methods for utility locations included electromagnetic (EM), ground penetrating radar (GPR), and magnetometer (MAG). Geophysical surveys (GWS) were also conducted to map near-surface areas of potential radiological impact and support the selection of additional (biased) sampling locations (as discussed in Section 2.1.4). These types of surveys have proven useful in the detection of gamma-emitting radioactivity; however, the differentiation of specific radiological constituents is not within the capabilities of walkover survey instrumentation.

The methodology for each type of geophysical survey is discussed in the following subsections.

2.1.5.1 Electromagnetic

The EM-61, manufactured by Geonics, Ltd, is a time domain metal detector (TDMD), and is useful in detecting and mapping shallow buried metallic objects. It is effective in delineating buried utilities and has often been used to map unexploded ordnance at military firing ranges. A TDMD survey usually consists of a series of parallel traverses separated by a fixed distance, typically one to five meters (m), to obtain sufficient site coverage for the desired objective. Data

are acquired along each traverse at the rate of about five per m (1.6 readings per foot). The instrument is coupled to a data logger for processing and interpretation.

The EM-61 TDMD was designed to map buried conductive objects, such as metal tanks, drums, and utilities. The instrument includes an antenna system consisting of a transmitter and receiver. The transmitter produces a series of EM wavelets which pulse into the earth 75 times per second. After each pulse, a secondary EM field is produced briefly from moderately conductive shallow soils, and for a longer period of time from buried metallic objects. Between primary EM pulses, a time delay is imposed upon the data logger to permit the secondary response from the soils to dissipate prior to the somewhat later and longer response from any buried metal that is present. The receiver senses the secondary responses from metallic objects and they are recorded by the data logger.

There is an upper and a lower coil (Channel [1] and Channel [2], respectively, on the data output) on the EM-61 TDMD. A common methodology for data presentation is to contour the output (in millivolts) of the lower coil, which is the most sensitive to shallow buried objects. A second contour map of the vertical gradient between the upper and lower coils (a dimensionless parameter), minimizes the effects of near surface metallic materials and is useful for mapping relatively deeper objects.

The EM-61 was interfaced directly with a DGPS, eliminating the need for a survey grid. The GPS coordinates were electronically recorded simultaneously with the EM measurements at each station using a data logger. Data were geo-referenced to North American Datum (NAD) 1983 NJ State Plane coordinates and National Geodetic Vertical Datum (NGVD 29) 29 Datum.

The EM survey for OUs 2 and 3 was implemented using a Schonstedt pipe locator. The MAC-51Bx consists of a receiver and a transmitter that simultaneously transmits on two frequencies - 571 hertz (Hz) (low frequency) and 82.5 kilohertz (high frequency). The receiver has a three position switch that allows the operator to change modes during operation (between low and high frequency or to magnetic readings), for cable and line tracing with break locating, pinpointing a ferrous metal target, or identifying and pinpointing an energized 50/60 Hz power line. In the low and high modes, the receiver's audio signal provides a sharp null when its tip is directly over the

target. In the magnetic mode (no transmitter required) the audio signal peaks when the receiver's tip is over the target, allowing the surveyor to locate underground ferrous pipes, water meters, water valves, property markers, or anything that has a magnetic field, including 50/60 Hz power lines. The surveys in OUs 2 and 3 were performed using the magnetic mode of the pipe locator.

Large-scale utilities maps were made available for review prior to field work. These maps appear to be designs rather than as-built diagrams as the true locations of subsurface utilities are only approximately correct. The true locations of the utilities were reviewed and verified by DuPont personnel, who cleared and approved subsurface work by issuing Excavation Permits. DuPont personnel reviewed and pre-approved every soil boring location in both OUs. DuPont also issued Work Order Permits that specified whether an excavation permit would be needed. DuPont personnel used their own utilities maps plus pipe locators (metal detectors).

2.1.5.2 Ground Penetrating Radar

Ground penetrating radar is a nondestructive geophysical method that produces a continuous cross-sectional profile of subsurface features without drilling, probing, or digging. GPR profiles are used for evaluating the location and depth of buried objects and to investigate the presence and continuity of natural subsurface conditions and features. GPR operates by transmitting pulses of ultra high frequency radio waves (microwave electromagnetic energy) into the ground via a transducer or antenna. The transmitted energy is reflected from various buried objects or distinct contacts between different earth materials. Reflected energy is received by the antenna which displays them on a Liquid Crystal Display display module in real time and simultaneously stores the data in a digital control unit for later processing, if appropriate.

The instrument used for OUs 2 and 3 was a Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar 3000 equipped with a 400 megahertz (MHz) antenna. This antenna is the best choice for targets up to 12 ft deep, exceeding the deepest anticipated target depth. The 400 MHz antenna was used with an odometer to correlate the GPR data with precise latitude/longitude coordinates. The odometer was set up such that one radar reading would be acquired every inch. The time range was selected as 60 nanoseconds (ns) and such a time range would allow a theoretical penetration depth of about three m (9.7 ft) assuming a signal velocity of 0.1 meters per nanosecond (an overall average for earth materials). At Chamber Works, the

depth of penetration was approximately six to seven ft, roughly corresponding to the depth to groundwater. GPS readings were recorded at the end points of each GPR line collected using a Trimble 3600 Series GPS antenna.

The GPR equipment used during the OU 1 investigation consisted of a System 10A+ control/display unit, mainframe/data storage unit, microcomputer, thermal printer, and 300 or 500 MHz antenna. The System 10A+ automatically displays, processes, and records cross-sectional profiles from an EM pulse that is transmitted into the subsurface. Depth of penetration is site-specific and is dependent upon the electrical characteristics of the site materials and the frequency of the transmitter; therefore, a site-specific calibration was conducted.

Typically, three parallel GPR traverses 20 ft long and five ft apart were operated first in one direction, then in the opposite direction with the middle traverse in each direction centered over the planned borehole. Screening of each location only required a few minutes to complete, and permitted minor adjustments of the planned location if subsurface anomalies indicated the potential presence of a utility either directly under or too close to the planned exploration.

The GPR data were represented as vertical cross-sections and by traces on the site maps. The cross sections and the map traces display areas of electrical anomalies that signify possible subsurface obstructions. The GPR traces are represented as thin magenta lines and the areas of electrical anomalies are represented as thicker blue lines. The GPR data obtained for the OUs are presented in Appendix A.

2.1.5.3 Magnetometer

MAGS are used to measure the direction and intensity of magnetic fields. The result can be used to locate buried metal objects or utilities. Earth Resources Technologyperformed the MAG surveys (along with GPR and metal detector surveys) in OU 3. MAG surveys were conducted in OU 3 along a traverse line every five ft (in one direction only) along a 20 ft by 20 ft grid, with the boring location positioned in the center of the grid wherever possible. The results were used to construct magnetic contour maps showing the occurrence of magnetic anomalies that might represent buried objects or utilities. These maps were utilized in combination with the GPR and metal detector surveys to determine the need to offset any boring locations.

2.1.5.4 Metal Detector

A metal detector survey was conducted in OU 3 to identify any active electric or communication lines that could be traced passively.

2.1.5.5 Gamma Walkover Survey

GWS identify areas of elevated radiological activity, and consist of measuring gamma radiation emanating from subsurface materials with an appropriate detector. The surveys conducted for the sitewide RI were performed using a pair of Bicron® G-5 Field Instrument for Detection of Low Energy Radiation (FIDLER) detectors. The FIDLER probe is a large area, Sodium Iodide (NaI) scintillation detector optimized for the detection of low-energy X-ray and gamma radiation detection. The detection sensitivity of this instrument to the refined natural uranium contaminant was estimated using a standard industry approach, as presented in the project Quality Assurance Project Plan (QAPP) (CABRERA 2003c). The approximate detection sensitivity of the FIDLER is five pCi/g of total uranium when contamination is at the surface and 75 pCi/g when four inches of cover material is present. Each FIDLER was coupled to Ludlum Model 2221 ratemeter/scalars and Trimble ProXRS GPS units.

For OU3, AOC 6, the GWS were intended to focus on the 10 specific areas of interest identified within the Field Sampling Plan (CABRERA 2004C). As the survey progressed, some areas were omitted based on real time data analysis, while others were extended in an attempt to delineate the horizontal extent of potential contamination. In areas where DuPont had stored inoperable vehicles and equipment, surveys were conducted by positioning the FIDLER detector as close to and under these vehicles and containers as was practical. These adjustments provided satisfactory results, causing no significant disruption to the intended survey patterns.

The radiological survey data were acquired using the GPS unit, which was capable of achieving real-time differential positioning to sub-meter accuracy. The radiological data were located and mapped interactively using the GPS unit, which was directly linked to the ratemeter, to allow for the automatic logging of count rate measurements at one-second intervals. The survey was conducted holding the detector within approximately two inches of the ground surface while walking at a speed of approximately 1.5 ft per second and moving the detector back and forth in a serpentine motion through a three foot arc. The audible indicator was turned to the "on"

position, providing the technician real-time identification of areas exhibiting elevated radioactivity. Areas where elevated readings were observed were further investigated by collecting additional measurements prior to continuing the survey path.

For the OU 1 survey results, the gamma count rate data were post-processed using Geosoft/Oasis™ analysis and visualization software. At the completion of the GWS for OUs 2 and 3, data stored in the GPS unit were transferred to a field computer for initial processing using Pathfinder™ software. For OU 2, the gamma count rate measurements were post-processed using ArcGIS Spatial Analyst™ analysis and visualization software. For OU 3, the gamma count rate measurements were post-processed using Surfer™ v8.0 surface mapping software.

Summary statistics were developed for each data set. Gamma count rates were evaluated and compared to the mean count rate for the survey area. Z-Scores, which represent the number of standard deviations the recorded result lies from the mean, were calculated based on the following formula:

$$Z - Score = \frac{CountRate - Mean}{StdDeviation}$$

A Z-Score of one means that there is an approximately 84.1% confidence level that the Z-Score value exists as a statistical outlier from the normally distributed data population. Z-Scores of two and three indicate confidence levels of 97.7% and 99.9%, respectively, that the Z-Score value exists as a statistical outlier from the normally distributed data population

Biased samples were selected at all locations where the gamma readings were greater than three times the standard deviation above the average of the GWS measurements.

Contour maps of the resulting Z-Score values were plotted over site base maps referenced to NJ State Plane coordinates for each AOC. All gamma surveys conducted for this RI are compiled in Appendix B; final GWS reports for the OUs are presented in Appendix B-1.

2.2 Geological Investigations

2.2.1 Surface Soil and Sediment

Surface soils are typically regarded as those naturally-deposited solids that are encountered on or near the land surface of the study area (e.g., zero to six inches bgs). The term '*soils*' contrasts with '*sediments*' which are normally encountered beneath water features such as rivers and lakes. Surface soils were characterized by the results of the GWS; characterization of sediment samples were represented by analytical results from the shallowest (zero to two ft interval) sample of each soil boring located in the middle of the ditch in OU 2, AOC 3 CDD.

2.2.2 Subsurface Soil

2.2.2.1 Geoprobe Sampling

A Geoprobe direct push rig is a hydraulically-powered ram, usually truck-mounted, that uses both static downward force and percussion to advance sampling and logging tools into the subsurface. The term "Direct Push" refers to tools and sensors that are "pushed" into the ground without the use of drilling to remove soil or to make a path for the tool. Downhole tools can collect continuous soil core or discrete soil samples, or soil gas samples. They can also collect discrete groundwater samples, and gather downhole lithologic data via a conductivity sensor probe. They can even be used to install small diameter monitoring wells. The Geoprobe does not require a large vehicle, as it combines a relatively small vehicle weight with percussion to advance downhole tools. Virtually no cuttings are produced during the sampling process, and probing tools create small diameter holes which minimize surface and subsurface disturbance. Geoprobe refusal can be caused by concrete rubble and other types of fill debris. In such cases, a hollow-stem auger device may be used to advance the soil boring.

The soil samples collected using Geoprobe direct-push technology in OUs 1 and 2 yielded two inch diameter cores. The planned total depth for borings in OU 1 and OU 2 was 15 ft and 10 ft, respectively. These depths allowed for collection of both soil and groundwater samples from below the water table. The plan also called for the borehole depths to be increased where on-site radiological measurements indicated that the soils at the bottom interval were potentially contaminated above the ISV of 14 pCi/g total uranium. After the borings were completed, temporary well casings and screens were placed in the boreholes to allow for water sample collection and for the advancement of a down-hole gamma detector.

A geologist logged the soil textures and collected samples. All soil logs created for the various sampling efforts are provided in Appendix C; Geoprobe soil boring logs are provided in Appendix C-1. Continuous cores were collected in five ft sections. A sample volume of approximately one kilogram (kg) is required for gamma spectroscopy analysis, which required approximately 29 centimeters (cm) of two inch diameter (5.1 cm) core. Due to the size of the sampling equipment and the necessary sample volumes, samples for geotechnical analysis were composed of a one foot core interval. In those cores with low recovery, the sample interval may have been composited from two foot intervals. One sample was collected at two foot intervals for radiological analysis. Gamma spectroscopy soil samples were collected into one liter (L) high-density polyethylene Marinelli beakers. At depth intervals where more soil sample was needed, an additional boring was made one foot away from the original location to collect more soil from the same depth interval.

Geoprobe holes were abandoned by tremie grouting upwards from the bottom of the borehole with a Portland cement/bentonite mixture.

Geoprobe Sediment Sampling

In order to obtain sediment samples in OU 2 (i.e., from the ditch centerline in AOC 3) a small barge was fabricated and used. The barge was constructed to U.S. Coast Guard safety standards, and was fitted with hand rails, toe boards, locking gates, and life vests. The sampling system consisted of a 100 pound slide hammer that was used to drive a Geoprobe macro-core sampler into the subsurface. The slide hammer was driven by a gasoline powered cat-head (capstan).

2.2.2.2 Cone Penetrometer Testing

Cone Penetrometer Testing (CPT) measurements can be used to delineate soil types and soil permeability. Unconsolidated soil to depths exceeding 30 m can be characterized using this technology. CPT measurements are a function of continuous or intermittent collection of data from the resistance to penetration. The mechanical properties of the soil result from *in-situ* stress conditions. The relationship between stress and soil deformation is interpolated by measuring probe tip resistance, friction sleeve resistance and dynamic pore pressure. Permeability measurements can be made during dissipation tests. The soil properties that control these

measurements are the ambient hydrostatic pressure, soil compressibility, soil strength, and soil permeability.

The CPT probe is composed of a hydrostatic pressure element containing a low-pressure transducer, an inclinometer, a friction sleeve containing strain-gauge load cells and a pore pressure transducer, a pore pressure element, and a cone tip. The standard cone has a surface area of 10 square centimeters (cm^2) and an angle of 60 degrees, and the friction sleeve has a measured surface area of 150 cm^2. The CPT probe transmits information via a multi-conductor cable to the receiver located at the surface. CPT can also be used to efficiently locate potential water-bearing zones for the collection of groundwater samples.

The CPT system is mounted on a truck generally weighing 20 to 30 tons. Equipment includes the CPT probe, down-hole tools, cabling, and a computer for data collection. The truck is positioned over the test location. Dissipation tests for soil permeability can be performed while the cone is held in a static position at a desired depth in a CPT hole.

Applied Research Associates, Inc. (ARA) of South Royalton, Vermont, was subcontracted to conduct the subsurface soil CPT investigation for the RI field program at OU 3 (AOCs 4 and 6). This was a very cost effective investigative method to initially screen for elevated uranium concentrations in such large areas, especially in AOC 4. A series of three penetrations was performed at each boring location. The initial penetration was accomplished with a piezocone incorporated into the first rod, and was used to obtain data for interpreting soil textures. The onboard computer processed the information received and provided continuous soil texture logs to the maximum depth pushed. A plot of the soil texture was then generated to assist in determining the appropriate depth to set the polyvinyl chloride (PVC) sleeve. Target depths were set below the clay layer to ensure that the soil below any deposited fill was logged. In boring locations where the clay layer was not readily discernable, the depth was set based on professional judgment as to the likely depth of fill material. This depth was selected based on information gathered from other boring locations in the general vicinity. Once a depth was determined, the CPT crew pushed a dummy tip to the desired depth to enlarge the hole enough to receive the PVC sleeve. The PVC sleeve, which was capped on the downhole end to prevent water infiltration, was then pushed to the desired depth, cut off at the top just above the ground

surface, and sealed with either duct tape or a well cap. Boring locations located near or along roadways where they could be damaged by vehicular traffic were cut a few inches bgs and sealed with a well cap.

At some boring locations, the material density was too high for the piezocone tip to penetrate a particular subsurface interval (i.e., tip refusal occurred) or the PVC sleeve failed during the push. In these instances, the rig was moved a few feet and additional attempts were conducted until a successful push was achieved and the CPT was able to reach the desired depth. The frequency of sleeve breakage or tip refusal was approximately 20%, with all but two of these instances being due to broken sleeves.

The geographic coordinates for all CPT locations were compiled, then located and staked using a Trimble ProXRS GPS unit, which achieves submeter horizontal accuracy. The data generated by the CPT investigation consisted of soil texture logs, which were used to interpret subsurface conditions. These CPT soil texture logs and ARA report are provided in Appendix C-2.

2.2.2.3 Hollow-Stem Auger Drilling

Hollow stem auger drilling is a rotary drilling method that does not require circulation of a fluid medium. Rather, the borehole is advanced and cuttings removed by a cutter head followed by a continuous flight of augers. H ollow stem augers are not intended for use in semi- or consolidated formations. W hen drilling, a cutting head is attached to the first auger flight (usually five or 10 ft long), and as the auger is rotated downward, additional auger flights are attached, one at a time, to the upper end of the previous auger flight. As the augers are advanced downward, the cuttings are carried to the surface along the continuous auger flights. The hollow stem or core of the auger allows drill rods and samplers to be inserted through the center of the augers. The hollow stem of the augers also acts to temporarily case the borehole, so that the well screen and casing may be inserted down through the center of the augers when the desired depth is reached, minimizing the risk of possible collapse of the borehole that might occur if it is necessary to withdraw the augers completely before installing the well casing and screen.

A CME-75 hollow-stem auger rig, equipped with 4.25 inch inner diameter (ID) augers that produced an 8.5 inch diameter borehole, was utilized for locations at OU 1 w here Geoprobe

refusal was encountered. Augers were advanced in five ft flights while sampling was conducted with three inch diameter, two ft split-spoons for continuous logging and sampling. The rig also had a coring bit that was run inside the augers for concrete coring.

2.2.2.4 Rotosonic® Drilling

The rotosonic drilling method uses a combination of rotary power, hydraulic pull down pressure, and mechanically generated oscillations to advance a dual line of drill pipe. Rotosonic drilling permits continuous sampling and rapid advancement of drilling tools even under difficult drilling conditions (i.e., when concrete rubble fill or other demolition debris is encountered). The top mounted hydraulically powered drill head transmits the rotary power, hydraulic down pressure and vibratory power directly to the dual line of pipe. The inner drill pipe contains a core bit and represents the core barrel sampler while the outer pipe is used to prevent the collapse of the borehole and in the construction of monitoring wells. This combination advances the inner core barrel sampler through the most difficult unconsolidated deposits (i.e., concrete rubble fill) without the use of water, mud, or air at rates equal to or greater than other conventional rotary methods when continuous sampling is required. The inner drill pipe is always advanced ahead of the outer drill pipe.

Rotosonic drilling was utilized for OU 3 based on observations of subsurface conditions during the Phase I CPT work, as well as the expectation that building rubble, concrete and debris would be encountered in this OU. D.L. Maher (a division of Boart-Longyear) of North Reading, Massachusetts, was contracted to conduct the rotosonic soil boring program for the RI. Soil borings were advanced in the unconsolidated material at the designated locations using rotosonic drill rig Model GP24-300RS.

At each boring site, the inner drill pipe and core bit were advanced to approximately five ft bgs. Once the inner drill pipe was set, the outer drill pipe was advanced down over the inner drill pipe to hold the borehole open. The inner drill pipe was mechanically lifted to the surface for core sample recovery. The core sample, which was contained in a polyethylene liner for ease of handling, was vibrated out of the inner drill pipe and placed on a sample tray for evaluation by the field geologist. The inner drill pipe was reinserted in the borehole, advanced to the next sample interval, and the core sample collection and retrieval process was repeated until the

desired depth was reached. Continuous core samples collected using this technique were five ft long and four inches in diameter.

The soil cores were collected for textural logging and sampling purposes. Upon recovery, the field geologist or driller's helper marked the starting and ending depths on the plastic sleeves containing the core material. The cores were then moved to the sample management area, which consisted of a plastic-covered table where radiological screening and geological logging activities occurred. While still in the plastic liner, each core was screened for gamma radiation using a FIDLER. The FIDLER was used to progressively scan six inch intervals using one minute count times. The detector was placed in a sliding jig to assure a consistent geometry between the sample and the beryllium window of the FIDLER. After gamma radiation measurements were recorded for each soil core, the plastic liner was slit along its entire length with a razor knife. Organic vapor concentrations were measured along the length of the core using a MiniRAE 2000 photoionization detector (PID). Soil textural properties were described in the soil boring log using the Unified Soil Classification System. Soil boring logs for subsurface drilling are provided in Appendix C-3.

2.2.3 Down-Hole Gamma Survey

In-situ gross gamma logging was utilized to assess the vertical distribution of gamma-emitting radionuclides with depth. Results of these measurements were used to select samples for offsite radiological analysis and to determine whether to extend a borehole vertically. As the name implies, the technology involves taking a series of gamma measurements for a fixed time interval (e.g., one minute) and specific depth interval (e.g., every 15 cm) from the bottom of a borehole to the top. Gamma measurements are collected with a NaI detector. Typically, a two inch diameter well would be logged with a one inch by one inch (1x1) NaI detector, while a larger (and more efficient) NaI detector could be used in larger diameter boreholes.

Bicron Model G-1, one inch by one inch cylindrical NaI detectors in stainless-steel waterproof housings were used to perform in-situ down-hole gamma measurements. The detectors were lowered through the PVC piezometer casings that were placed in the boreholes. The NaI down-hole detector did not have adequate sensitivity to measure uranium concentrations at or near the 14 pCi/g (seven pCi/g U-238) ISV, but were designed to support the selection of biased sampling

locations in each borehole to appropriate depths, within the confines of their sensitivity limitations. Minimum detectable concentrations (MDC) calculations are discussed in the QAPP (CABRERA 2003c, Appendix H). The methodology used to determine the NaI scintillation detector scan MDC is based on the Nuclear Regulatory Commission's (NRC) NUREG –1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" (NRC, 1997). The MDC for total uranium in 50 year equilibrium with progeny for the one inch by one inch NaI downhole scintillation detector is estimated to be 22 pCi/g based on Poisson statistics utilizing sample background values and assuming the background gamma fluence distribution is constant. Large variations in background within the soil may result in a non-Poisson distribution. The MDC for this case is conservatively estimated as 142 pCi/g.

The subsurface survey data was also used to make real-time field decisions for additional sample selection and extending the vertical sampling if readings were greater than three standard deviations over the average within a borehole. Downhole gamma survey results are provided in Appendix B-2.

2.2.3.1 Spectral Gamma Logging

Spectral gamma logging was also performed during the CPT investigation at OU 3. After the cone penetrometer tools were withdrawn from each borehole, a one inch diameter PVC sleeve was inserted into the CPT hole to be used for in-situ spectral gamma logging. The gamma logging equipment was cart-mounted and utilized a system designed and built by Pacific Northwest Geophysical that was capable of automatically logging a borehole at preset count and depth intervals. The detector was a 0.8 inch by four inch cesium iodide detector mounted in a stainless steel cone that included the photo-multiplier tube and back end electronics (i.e., pre-amp and analog-to-digital converter). A nuclear industry module stored the spectral data in 256 discrete channels. Each boring was evaluated for total depth and water level prior to commencing logging operations. Locations having water levels greater than a few tenths of a foot (the depth that could affect the detector) were pumped dry prior to lowering the detector into the borehole.

Once the integrity of the hole was confirmed, the detector was lowered to the bottom of the sleeve and the logging system was initiated to acquire gamma information. Sequential logs were collected every half-foot from the bottom of the sleeve to ground surface. A 200 second count time was used for each gamma acquisition. The operator monitored the detector system to identify any significant increase in count rate. Data were transmitted on a daily basis to the home office for post-processing and identification of the radiological constituents. After the gamma logging was completed, the CPT holes were abandoned using cement grout. The spectral gamma logs are included with the downhole gamma survey reports in Appendix B-2.

2.2.4 Geiger-Mueller Core Scan

Soil cores were scanned following removal of the acetate core sleeve in order to identify elevated uranium activity in soil by using Ludlum Model 44-9 pancake probes, also known as Geiger-Müller (GM) detectors, coupled with Ludlum Model 3 meters. The Model 3 meter is an instrument that can be coupled with GM detectors or other scintillation detectors. The estimated detection sensitivity of the GM soil core measurements was approximately 20 pCi/g, which is greater than the 14 pCi/g ISV. However, the GM soil core scan was used in combination with the down-hole NaI detector to select samples for laboratory analysis. Discrete samples were selected for sampling from soil core segments where GM measurements were elevated. In the event that down-hole gamma measurements and GM measurements were not in agreement, results of the GM measurements were used because they directly measure radiation from the soil core that was removed (i.e., the soil became the discrete sample).

2.2.5 Test Pits

A test pit is a backhoe-dug hole whose purpose is to characterize the subsurface by direct observation of excavated materials. A test pit can be of virtually any length, width, or depth, and is only limited by the size of the equipment, the properties of the soil materials, the depth to groundwater, and safety considerations (e.g., release of air-borne contaminants from contaminated media, slope stability). The test pit program implemented in support of the soil investigation at OU 1 used a CASE CX160 excavator equipped with a 36 inch quick disconnect bucket and grappler attachment. The bucket was primarily used to remove miscellaneous debris and for soil excavation. Once all the contents of the test pit were removed by the excavator and placed on the liner at the surface, direct readings were obtained as described in Section 2.2.4.

The radiological technician first took a direct reading on various types of debris (metal springs, metal support structure, brick, and fill dirt) using a Ludlum 2360 instrument with a 4389 probe. Direct gross counts were converted to net counts and then converted to disintegrations per minute (dpm)/100 cm^2 using the equipment efficiency. Wipe samples were then collected on selected debris and measurements obtained using a Ludlum 2929 instrument.

Handheld instruments and wipe samples were used to characterize potential radiological surface contamination on the debris. Direct measurements performed with the handheld instruments are not radionuclide-specific and provide estimates of total (fixed plus removable) alpha and beta activity in units of dpm/100 cm^2. Wipe sample analyses provide estimates of removable alpha and beta activity, also in units of dpm/100 cm^2. Because these types of survey activities were not initially planned, an ISV was not established for total and removable alpha and beta activity; however, USACE Engineer Manual EM 385-1-80, Radiation Protection Manual, (USACE, 1997) establishes acceptable surface contamination levels for natural uranium as:

- Average Maximum Removable:

5,000 dpm α/100 cm^2 15,000 dpm α/100 cm^2 1,000 dpm α/100 cm^2

The average and maximum contamination limits apply to total surface activity (i.e., fixed plus removable). The "maximum" surface contamination limit applies to an area no greater than 100 cm^2. The removable limit applies to wipe samples collected by wiping the area with a dry filter or soft absorbent paper, and applying moderate pressure. Only natural uranium emits one alpha per decay and approximately one beta per decay in a 1:1 ratio. Thus, these limits can be compared directly with alpha and/or beta measurements.

Wipe samples were then taken on selected debris and measurements obtained using a Ludlum 2929 instrument. A geologist also logged the contents removed from the test pit. A hose was used to mist the area with water to prevent dust from the debris or soil being released into the air. Test pit logs for OU 1 are located in Appendix C-4.

2.2.6 Concrete

The concrete coring in OU 1 was conducted using a six inch diameter concrete core device that was set on top of the existing concrete slab or from buried remains of concrete foundations and

structures. One concrete sample was collected from each coring. Soil samples were then collected immediately below the concrete using split-spoon or direct-push sampling techniques. Generally, the boreholes at the concrete core locations were advanced to a depth of approximately five ft below the concrete surface. Prior to collecting the concrete samples, a skid steer loader was used to clear the existing gravel and soil cover from the concrete slab in locations marked for sampling. After the areas were cleared of the gravel and soil cover, the radiation safety officer conducted field readings to assess what level of radioactivity was present on the concrete slab. The concrete slab was encountered at approximately six inches in depth. Samples were required to be broken into six inch sections. Only one concrete sample was collected from each coring location. Soil samples were then collected immediately below the concrete using split-spoon or direct-push sampling techniques.

The concrete coring machine could only be used if the concrete was encountered within the first two ft bgs. The selected alternative method was to first advance the borehole using hollow-stem auger techniques to subsurface concrete (rubble or foundation), and then attempt to obtain a concrete core using conventional rotary coring techniques. The downhole assembly consisted of a diamond-impregnated NX core bit and a core barrel connected to drill rods, which transmitted drilling water and mechanical power to the bit. Collection of the concrete at depth using this technique was only possible where the concrete was fairly continuous (not broken up into pieces of rubble), and where metal reinforcing bars were not present.

2.3 Groundwater and Surface Water Investigations

2.3.1 Temporary Piezometers

Groundwater sampling from small ID piezometers is limited to collecting grab samples through disposable polyethylene tubing either by bailing or via a peristaltic pump. High quality groundwater samples from a piezometer are not possible since the media surrounding the downhole open end of the pipe are undeveloped and cannot be sampled in a manner that would produce non-turbid samples representative of the surrounding aquifer. Analytical results from piezometers can only be used to quantify groundwater elevation or as a screening tool to identify gross trends in contaminated media and to plan potential locations for future monitoring wells.

Sampling of piezometers was conducted as part of the initial groundwater investigation in OUs 1 and 2. Filtered and unfiltered samples were obtained using a peristaltic pump and dedicated tubing. While USEPA low-flow sampling protocol does not apply to temporary sampling points, low flow rates were maintained during sampling to minimize the suspension of particulates. For background sampling as well as additional sampling conducted in OU 3 in support of the BRA, the piezometers were installed with five ft pre-packed screens, allowing the sampling of unfiltered groundwater only. These wells were also sampled with a peristaltic pump and dedicated tubing. USEPA low flow sampling protocols (USEPA, 1998) were used for the piezometers equipped with pre-packed screens.

After completion of groundwater sampling, the piezometers were abandoned by removing the casings and screens and filling the boring with bentonite slurry.

2.3.2 Sampling via Geoprobe

Geoprobe equipment can be used to collect groundwater samples in either of two ways: (a) collecting grab samples through downhole tools in the same manner as groundwater sampling from temporary piezometers; and (b) from properly constructed monitoring wells installed in the same manner as permanent, dedicated monitoring wells as described below. Geoprobe wells may use smaller diameter well and riser materials than conventional well installation. It should be noted that some regulatory agencies may not approve the use of Geoprobe-installed wells, because it is not as easy to control the installation of the sand pack around the well screen or the bentonite-cement seal above the screen.

2.3.3 Monitoring Well Installation and Development

Groundwater monitoring wells were installed according to NJDEP regulations (NJDEP 1997). Monitoring wells were installed using either an 8.25 inch (outer diameter) hollow-stem auger in the overburden (OU 1 and 2) or by rotosonic drilling (OU 3). Prior to the start of drilling, and between each well location, all drill rods, augers, bits, and associated tools and equipment were steam-cleaned at the designated on-site decontamination area. All fluids generated from the decontamination area were containerized and labeled in accordance with DuPont and USEPA requirements. Well locations and elevations were surveyed by a NJ licensed professional surveyor. Northings and eastings are referenced to NAD83 NJ State Plane Coordinates. Vertical elevations are referenced to the North American Vertical Datum (NAVD) 88 datum.

Well construction materials were two inch diameter Schedule 40 PVC threaded, flush joint well casing, with 0.010 inch (10-slot) slotted Schedule 40 PVC screen. The sand-pack consisted of 20 to 40 silica sand installed around the well screen to a height of one foot above the screen (whenever possible). A centralizer was installed at the top and bottom of the screened interval. A bentonite grout seal was placed on top of the sand pack, and the remaining annular space above the bentonite seal was grouted to the surface using a Portland cement/bentonite grout mixture.

The surface completion for each non-flush mount well consisted of a section of six inch diameter steel casing with locking cap along with a two ft by two ft by 4 inch concrete pad that were installed at each well location. The wells were secured with a lock, and the outer protective well casings were painted with bright yellow paint and numbered. Three three inch diameter, five ft long concrete-filled guard posts were installed around each well. The guard posts were recessed approximately two ft into the ground and set in concrete, outside the concrete pad surrounding each well or well pair.

Table 2-6 presents the well construction details for all monitoring wells installed in support of the sitewide RI. Figures 2-1 and 2-2 present well design schematics for both the A and B aquifer monitoring wells. The design for the one C aquifer well in AOC 2 is shown in Figure 2-3.

Newly-installed monitoring wells were developed prior to sampling. Well development is conducted to ensure removal of fine grained sediments (fines) from the vicinity of the well screen. This allows the water to flow freely from the formation into the well, and also reduces the turbidity of the water during sampling. Well development was initiated no sooner than 48 hours following completion in order to allow the well seals to cure. Wells were developed using a combination of surging (with surge blocks) and pumping. A minimum of three standing well volumes were removed from each well, with development continuing until turbidity measurements achieved the target turbidity of 10 Nephelometric Turbidity Units (NTU) on two consecutive readings (30 minute intervals) or until the turbidity readings were stabilized to within plus or minus (±) 10% for three consecutive readings. All purge water was collected and held as IDW for characterization and disposal, as discussed in Section 2.4. Purge waters were eventually disposed of at U.S. Ecology in Grandview, Idaho.

Groundwater sampling was conducted using low flow purging and sampling. Low-flow purging and sampling protocols were followed in accordance with USACE guidance EM 200-1-3 (USACE, 1994) and the USEPA Region II Groundwater Sampling SOP *Groundwater Sampling Procedure Low Stress (Low Flow) Purging and Sampling* (USEPA, 1998).

2.3.4 Water Level Measurements

Intrinsically-safe electronic water level meters were used to measure water levels in the wells prior to sampling. Measurement points were identified on the well casings for consistent data collection. Groundwater levels were measured to the nearest 0.01 ft. Before recording water levels, field personnel confirmed the initial reading with a second measurement.

Water level measurements were used to determine groundwater flow direction in the Chamber work site aquifers, and to prepare groundwater elevation contour maps

2.3.5 Slug Tests

Pneumatic slug tests were conducted to determine the local hydraulic conductivities in the A and B aquifers. In pneumatic slug testing, the well head is sealed and air pressure is used to displace/lower the water level. As air pressure in the well is increased, the water level falls until the water pressure "up" and the air pressure "down" are equal. Once the water level is stable, a release valve is quickly opened, instantaneously releasing the air pressure. The water level recovers (rising head test) without splashing and the pressure transducer and data logger/computer record the changes in water level and time. Figure 2-4 presents a diagram of the pneumatic slug test equipment.

Tests were conducted in accordance with the procedures defined in the American Society for Testing and Materials (ASTM) Method D4044-96 *Standard Test Method for (Field Procedure) for Instantaneous Change in Head (Slug Test) for Determining Hydraulic Properties of Aquifers* (ASTM, 1991).

2.3.6 Surface Water

Surface water samples were collected from the CDD using a direct dipping (or dip cup) method. The sample container is dipped directly into the surface water for sample collection. The top or opening is pointed upstream allowing the sample to be collected directly into the container. Prior to obtaining an analytical sample, a small beaker or the sample port of the potential of hydrogen:

log of the hydrogen ion concentration (pH)/specific conductivity meter is used to collect a small water sample and record the temperature, pH, and specific conductivity readings in the field log book.

2.4 Investigation-Derived Waste Management

IDW included soil cuttings from the soil-boring investigations, used personal protective equipment and sampling materials (including decontamination water) and groundwater from well development and sampling. IDW was transferred to 55 gallon drums for storage on a daily basis. All drums were clearly labeled using a permanent paint pen. The label information included the contents of the drum (e.g., solid waste), a unique numeric identifier, and the source area (i.e., specific AOI) where it was generated. A staging area was established in each AOC for the temporary storage of the material. The IDW was transferred to the DuPont 90 day storage area until the analytical laboratory results were available to determine the disposal requirements. Composite samples were collected from the drums for IDW characterization. A listing of the analytical parameters evaluated for IDW characterization is provided in section 2.5.1.2. A breakdown of IDW volumes by AOC, as well as analytical data for IDW characterization results and disposal actions are provided in Appendix D.

2.5 Sample Analysis: Methods and Quality Assurance

An overall summary of samples collected during the course of the Sitewide RI and the type of analytical methods used for radiological and chemical constituents is provided in Table 2-7. The number of samples collected by media in each AOC as well as the number of onsite and offsite laboratory analyses is summarized in the table. In addition, Tables 2-8 (radiological) and 2-9 (chemical constituent) summarize the type of analyses performed for soils at each sample location.

2.5.1 Soil Samples

2.5.1.1 On-site Screening of Soil Samples by Gamma Spectroscopy

Discrete soil samples from every two foot interval of each boring were screened in an on-site gamma spectroscopy laboratory in OU 1 and OU 2. On-site laboratory analyses were designed to yield adequate sensitivity to meet the ISV and served as the primary screening result for field decision-making for selection of samples for offsite analysis, and expanding the borehole transect vertically or horizontally. Soil samples were analyzed in one L Marinelli beakers. On-

site gamma spectroscopy analyses were performed using an N-type high purity germanium (HPGe) gamma spectroscopy system measuring U-238 decay progeny. U-238 decay progeny emit discrete energy gammas that can be used to identify and quantify total uranium activity concentrations in discrete samples. The concentration of total uranium in soil samples was reported based on the concentration of Th-234, which is the first decay progeny of U-238. The conversion was made using the following equation:

Concentration [total uranium] = Concentration [Th-234] / 0.489

Values for minimum detectable activities (MDAs) and total propagated uncertainties (TPUs) for total uranium were calculated using the same method, based on Th-234 MDAs and TPUs. The conversion is made using the accepted standards for uranium isotopic equilibrium as reported in the American National Standards Institute (ANSI) standard N13.22-1995 (ANSI 1995). Sample mass was estimated using a laboratory balance, and samples were counted without performing physical processing such as drying and grinding. The approximate detection sensitivity of the on-site gamma spectroscopy laboratory was four pCi/g of total uranium, well below the investigative screening level of 14 pCi/g. Since the ISV is derived from conservative risk-based criteria and average background concentrations, the level of sensitivity is adequate to make decisions regarding additional sampling in the field.

The onsite laboratory was used during the OU 1 and OU 2 initial investigations. Subsequent investigations did not utilize an onsite laboratory but samples were identified for offsite laboratory analysis based on GM scanning results and other field screening methods. Samples from the OU 3 soil investigation, sitewide groundwater investigation, and the additional sampling in 2007 in support of the BRA were only sent for offsite laboratory analysis.

2.5.1.2 Off-site Analysis of Soil Samples

The results of sample screening analyses were used to select samples for off-site gamma spectroscopy analysis. For OU 1 and OU 2, samples were sent to Eberline and Paragon Analytics for radiological and chemical analysis. The approximately 10% sample selection for alpha spectroscopy and additional samples for radiological analysis were chosen where higher radiological activity was indicated. A sample that exceeded the ISV was selected for off-site

analysis. If no sample exceeded the 14 pCi/g criterion, then sample selection was based on the GM core frisk and downhole gamma survey. If elevated radiation readings were not observed during the surveys, then two samples were collected from the vadose zone.

For OU 3, two soil samples from each borehole were selected for off-site analysis. The criterion for selection was based on the results of the GM core frisk. Samples selected for offsite analysis were placed in stainless steel bowls, homogenized, and transferred to laboratory-provided plastic sample containers. When the supply of laboratory containers was depleted, clean 16 ounce Ball Mason Jars were used.

Samples were submitted to Paragon Analytics, Inc. for radiological analysis as well as chemical analysis for health and safety purposes and IDW considerations. Chain of custody (COC) records accompanied all sample shipments and were used to specify to the laboratory which analyses to perform. Table 2-10 presents radiological and chemical analysis parameters for the solid (soil and sediment) and aqueous samples during the Sitewide investigations.

Gamma spectroscopy, with and without radium daughter in-growth, (USEPA Methods 901.0 and 901.1) was performed on these soil samples. HPGe detectors were used by Paragon for the gamma spectroscopy laboratory analysis. In support of the addition of Th-230 to the ROPC list, available stored soil samples were also analyzed for isotopic thorium via alpha spectroscopy. Paragon uses a modified version of the ASTM 3972-90 standard that is applicable to other actinides (thorium, plutonium, americium, etc.) for both soil and water samples.

In addition, quality control (QC) measures were implemented that included collecting field duplicate samples at 10% of the primary sample locations. The field duplicates were analyzed by the project subcontract laboratories, Eberline and Paragon Analytics, Inc. Quality assurance (QA) split samples were collected at 5% of the primary sample locations. The QA splits were analyzed by the USACE's contract laboratory, Severn Trent Laboratories in Earth City, Missouri.

For chemical contaminants, QC sampling typically includes the collection of equipment blanks to confirm the effectiveness of decontamination techniques. However, for radiological

contaminants, equipment decontamination is monitored through the collection of smear samples from the sampling equipment. Smear samples were collected at the primary sample locations and analyzed onsite using a Ludlum Model 2929 alpha/beta counter.

The on-site screening laboratory results were also used to select approximately 10% of the total samples for IDW characterization testing that included Toxicity Characteristic Leaching Procedure for volatile organic compounds (VOC) analysis, semivolatile organic compounds (SVOC) analysis, Pesticides/Polychlorinated Biphenyls (PCBs); TAL metals; hazardous characterization testing (ignitability, corrosivity, and reactivity); and paint filter testing. Off-site radiological samples and samples designated for IDW characterization were biased to the samples with highest estimated uranium activity concentrations.

Physical/Geotechnical and Geochemical Analyses

Ten percent of the soil samples collected from within each area and submitted for off-site radiological analyses were also to be analyzed for grain size analysis, moisture content, specific gravity, liquid and plastic limits, pH, cation exchange capacity, and total organic carbon (TOC). TOC was also analyzed in all soil samples collected in the Background Reference Area.

To identify mineralogy and gain a better understanding of mobility factors a number of geochemical analyses of soil samples was performed in OU 1 and OU 2. X-ray diffraction (XRD) with supplemental scanning electron microscope (SEM) analyses were conducted on up to 10% of soil samples submitted for off-site radiological analyses in order to determine the form of uranium present in the soil samples. Batch tests (ASTM D 4646 or ASTM D 4319) to determine the partition coefficient (K_d) for U-238 at the pH conditions as measured in the field were conducted on 10% of the soil samples. The samples for these analyses were selected from the core samples that were also sent to the onsite laboratory for gamma spectroscopy analysis. Table 2-11 presents the geotechnical parameters analyzed in the RI soil samples.

2.5.2 Groundwater Samples

2.5.2.1 On-Site Analysis of Water Quality Parameters

To support contaminant fate-and-transport estimates, selected geochemical analyses of groundwater samples were performed onsite. These analyses were performed for reactive ions

that would most likely change (react) during transport to offsite laboratories. Onsite analyses were performed for sulfide, nitrite, ferrous iron and aqueous hydrogen peroxide concentrations.

Well-stabilization parameters were measured onsite using multi-parameter meters equipped with flow-through cells (YSI meters). The parameters that were measured included dissolved oxygen concentration, redox potential, pH, specific conductance, temperature and turbidity, and as required by the low flow purging and sampling procedure. The water quality parameters are presented in Table 2-12.

Sulfide

Sulfide concentrations were measured onsite using the Methylene Blue Method (HACH Method 8131). The minimum detection limit of the method is 0.01 milligrams per liter (mg/L). Grab samples were collected and analyzed on-site after the wells had been fully purged.

Nitrite

Nitrite concentrations were measured using the colorimetric Diazotization Method (HACH Method 8507). Grab samples were collected and analyzed on-site after the wells had been fully purged.

Ferrous Iron

Ferrous iron concentrations were measured in all wells by the 1, 10 Phenanthroline Method using programmable HACH colorimeter (HACH Method 8146). Grab samples were collected and analyzed on-site after the wells had been fully purged.

Hydrogen Peroxide

Hydrogen peroxide concentrations were measured by two different methods. The first method used was the sodium thiosulfate titration method (HACH Method HYP-1). After use in the field, it became evident that there were interferences with the method. The manufacturer states that chlorine interferes with the sodium thiosulfate titration method, but field testing also showed that chloride ion also interferes with this method. The second field method used to measure hydrogen peroxide concentration was a test-strip method which showed similar interferences as the titration method.

Dissolved Oxygen

Dissolved oxygen (DO) concentrations were measured using the amperometric method, which utilizes a DO sensor.

Redox Potential

Redox potential (Eh) or oxidation-reduction potential (ORP) was measured using a platinum redox and silver: silver-chloride reference electrode pair. ORP values can be converted to Eh values by adding approximately 200 millivolts (mV) to the ORP values. Eh is seldom measured directly in the field but may be done using the standard hydrogen electrode. All values used in this report are unconverted ORP values.

pH

Temperature-compensated measurements of pH were collected using a flow-through cell. Measurements of pH ranged from circum-neutral to basic. Areas with high pH also tended to have low redox potential.

Specific Conductance

Specific conductance was measured using an auto-ranging four electrode cell with automatic temperature compensation. Measurements were taken using a flow-through cell.

Temperature

Temperature was measured with a standard thermistor using a flow-through cell.

Turbidity

Turbidity was measured in a flow-through cell using a submersible turbidity probe.

2.5.2.2 Off-Site Analysis of Groundwater and Surface Water Samples

A discussion of the off-site analysis methods is presented below. In addition to the primary analytical samples**,** Quality Assurance/Quality Control (QA/QC) samples were collected during the investigation. Field duplicates of groundwater and surface water samples were collected for analysis at a frequency of 10% of primary samples. One wipe sample was collected for every two items of decontaminated sampling equipment (gross alpha and beta only) and analyzed using the onsite alpha-beta counter. W ipe samples are collected to check for potential cross

contamination when decontaminated sampling equipment is used. One set of Matrix Spike/Matrix Spike Duplicates (MS/MSDs) were collected for analysis of isotopic uranium and total radium only. The MS/MSD portion of the sample was collected in containers separate from the routine sample to provide sufficient sample volume and to allow for the assessment of unspiked results for field precision. Split samples were collected for analysis of radiological parameters at a frequency of 5% of primary samples.

Table 2-12 presents the offsite analytical methods used for the groundwater and surface water sampling.

2.5.2.2.1 Aqueous Uranium

All groundwater and surface water samples were analyzed for Isotopic Uranium using American Society for Testing and Materials (ASTM) 3972-90.

2.5.2.2.2 Other Radionuclides

In addition to uranium, groundwater and surface water samples were analyzed for the radiochemical parameters of Gross Alpha/Gross Beta (USEPA Method 900), Ra-226/Ra-228 (USEPA Method 903/904) and isotopic thorium (modified ASTM 3972-90).

2.5.2.2.3 Volatile and Semi-Volatile Organic Compounds

Groundwater samples from OU 1 and OU 2 wells were collected for benzene, toluene, ethylbenzene, and xylene (BTEX) analysis via Method 8260B. Groundwater analysis for VOCs by Method 8260B and SVOCs by Method 8270 was performed for select groundwater samples collected from OUs 1, 2, and 3 in support of the BRA.

2.5.2.2.4 Aqueous Metals

Although they were not identified as COPCs for the RI, groundwater and surface water samples were analyzed for metals. Metals data provides useful information for the interpretation of geochemical conditions, as well as for use in the BRA. Water samples were collected for laboratory analysis of the concentrations of the 23 TAL metals, which were analyzed using Method 6010B.

2.5.2.2.5 Major Cations and Anions

While major cations and anions were not identified as COPCs for the RI, concentrations of these constituents were analyzed to interpret their effect on uranium geochemistry. Concentrations of

the inorganic ions chloride, fluoride, sulfate, phosphate (as phosphorous), nitrate/nitrite, and alkalinity were measured, as well as the metals calcium, magnesium, sodium, and potassium.

Alkalinity was measured by USEPA Method 310. C hloride, fluoride, sulfate, phosphate (as phosphorous), and nitrate/nitrite were analyzed using USEPA Method 300. C alcium, magnesium, sodium, and potassium were analyzed using USEPA Method 6010B**.**

2.5.2.2.6 Off-Site Laboratory Quantification of Uranium in Soils and Water Samples

An important Data Quality Objective (DQO) for the analytical program is to obtain, to the extent practical, radiological MDCs at or below potential cleanup criteria for the site. The MDCs have been compared to federal and State of NJ human health risk-based criteria for reference. The purpose of this comparison is to establish that the MDCs of the analytical techniques used to measure site uranium concentrations are sufficiently low to conclude that a non-detect is below these reference criteria.

To ensure that adequate sensitivity is achieved in off-site laboratory analyses, conservative screening values published by various regulatory agencies were considered in determining required laboratory MDCs. Table 2-13 and 2-14 provide required offsite laboratory MDCs for soil and groundwater samples, respectively. Required MDCs were set at a small fraction of the conservative screening values.

As indicated in these tables, which compare the conservative regulatory screening levels to the MDCs, gamma spectroscopy and isotopic uranium analysis being performed on s oil and groundwater sample respectively, provide the required sensitivity below these screening values. The primary analytical laboratory DQO is therefore met by obtaining the lowest practical MDC that is below the conservative screening value.

2.6 Air Sampling

Air quality monitoring was assessed throughout the field investigations primarily as a means to monitor the health and safety of site workers, DuPont personnel, and the public, as potential exposure to either uranium-bearing dust or DuPont wastes was possible during intrusive sampling activities caused by disturbance of subsurface soils.

Air monitoring methods included breathing zone monitoring, perimeter air monitoring, and soil vapor collection where warranted (e.g., in OU 3). A discussion of the sampling field methods, as well as the health and safety environmental monitoring records, is provided in Appendix E.

2.7 Ecological Investigations

A site visit was conducted at the DuPont Chambers Works on 15 October 2003 to investigate ecological conditions of OU 2 in the area of the CDD to determine the need for a radiological ecological risk assessment. The purpose of the site visit was to identify any ecological receptors and exposure pathways in or near the CDD (AOC 3). In addition a site visit was also conducted in late July 2007 for the purpose of further assessing ecological conditions at each AOC, particularly in the northern section of AOC 4 (Historical Lagoon A) along the Delaware River. This area is also referred to as AOI 1 in AOC 4 (DuPont's SWMU 5). Information was collected during the reconnaissance and historical aerial photographs reviewed.

Site visit observations were used to complete Region VI's Ecological Exclusion Criteria Worksheet and Ecological Assessment Checklist. Completion of the checklist involves 1) collecting information related to its operation, physical site characteristics, ecological habitats and receptors utilizing the Ecological Exclusion Criteria Worksheet and determining if incomplete or insignificant exposure pathways exist at the AOC that eliminate the need for further ecological evaluation, and 2) if an area cannot be excluded from further evaluation, collecting more detailed information about ecological areas utilizing the Ecological Assessment Checklist to assist in further ecological risk evaluations. If the affected property meets the exclusion criteria, no further evaluation of ecological risk will be required for the AOC. If the affected area does not meet the exclusion criteria, then a screening level ecological risk assessment will be performed for the AOC. Based on site conditions and the results of the ecological exclusion checklist AOCs 1, 2, 5 and 6 were excluded from further ecological evaluation. These areas are located within the active manufacturing area of Chambers Works and do not contain appreciable ecological habitat. The checklists were completed as part of the BRA and are included in Appendix H.

2.8 Data Review, Verification, and Usability

This section presents a summary of the analytical data review process during the different phases of the RI. The review consisted of evaluating the accuracy and precision of the onsite and offsite

radiological results for soils and groundwater. A QC review of selected chemical data was also performed. Analytical data received from the contract laboratories were provided via a series of Sample Delivery Group (SDG) packages. Radiological data was reviewed and verified using the Radiological Validation and Verification spreadsheet provided by the USACE (Buffalo District). The radiological parameters included in each SDG were reviewed for accuracy and completeness of sample data, QC information, and instrument data. The laboratory used internal qualifiers for the data sets, but the verification form utilized qualifiers outlined in section 8.3.3 of the Multi-Agency Radiological Laboratory Analytical Protocols Manual, which was also used as the basis for the verification process.

In addition to the laboratory QA review, all data deliverables were evaluated for completeness and overall sampling and analytical performance. The Automated Data Review software module, developed by Laboratory Data Consultants was used in the data review step. In-house QA/QC review procedures are described in the Final QAPP (CABRERA 2003c). A summary report of QA/QC evaluation results is included in Appendix M.

2.8.1 Evaluation of the Accuracy of the Onsite Gamma Spectroscopy

A statistical evaluation was performed to measure the accuracy of on-site gamma spectroscopy laboratory results with respect to the off-site gamma spectroscopy laboratory results. Detected sampling results for both on-site and offsite gamma spectroscopy laboratory results were used to determine the Pearson correlation coefficient between these two sets of sampling results. A correlation statistic ranges from –1 (perfect negative correlation) to 1 (perfect positive correlation). A correlation of 0 means there is no correlation between the variables. In addition to correlation, an associated p-value is calculated that measures the probability (ranging from 0 to 1) for which the true correlation is zero. A high p-value (close to 1) means the hypothesis of zero correlation between the variables cannot be rejected. A low p-value (< 0.10) means the hypothesis of zero correlation between the variables is rejected at the 0.10 significance level and that a significant positive or negative correlation exists between the variables.

Table 2-15 presents the results of on-site and off-site gamma spectroscopy laboratory results for total uranium. The results showed that the Pearson correlation value is 0.998 and the p value is 0. That means, that the hypothesis of zero correlation between both sampling results is rejected

and that a significant positive correlation exists between offsite and on-site laboratory results for total uranium. Therefore, based on these results of the statistical evaluation the onsite gamma spectroscopy screening data for total uranium is sufficiently accurate to support nature and extent determinations and future CERCLA decisions at the Site.

2.8.2 Confirmation of Natural Uranium

Alpha spectroscopy was performed on soil samples to support the assumption that the uranium at the Site is in natural isotopic ratios. This assumption is important because it is used as the basis to estimate total uranium activity concentrations from gamma spectroscopy analyses. Gamma spectroscopy reliably quantifies only U-235 and U-238. To estimate total uranium from gamma spectroscopy analyses, assumptions need to be made regarding the U-234 component. If natural uranium is present the U-234 activity concentration is equivalent to U-238. If depleted or enriched uranium is present, the U-234 component would be different, on a relative basis, than in natural uranium.

A statistical evaluation was performed and is shown in Table 2-16. As shown by the data the U-234 to U-235 ratio for each sample is near unity, the expected ratio for natural uranium. These data support the natural uranium assumption used to interpret other data collected during the Sitewide RI.

3.0 PHYSICAL CHARACTERISTICS OF SITE

The following section summarizes the physical and environmental characteristics of the Chambers Works site that are relevant to identifying potential migration pathways, transport mechanisms, and potential receptors, both current and future. This section provides a foundation for subsequent discussions on the nature and extent of contamination, including detailed information on physical characteristics specific to each OU (Sections 4.0, 5.0 and 6.0). The following information also provides a basis for the discussions on Contaminant Fate and Transport (Section 7.0).

3.1 Meteorology

Climatological data for the Chambers Works complex is presented in Table 3-1. Climatological data were collected at the National Weather Service Station at New Castle County Airport, Wilmington, Delaware (DE) for the period 1948 through 2000. This location is approximately eight miles northwest of the site. The mean temperature in this area is 54 degrees Fahrenheit (° F), ranging from a minimum monthly mean temperature of 23° F in January to a maximum monthly mean temperature of 86° F in July. The average annual precipitation for this period is 41.5 inches, with a monthly average precipitation of 3.5 inches. The highest monthly mean precipitation is in July with 4.3 inches and the lowest monthly mean precipitation is in October with 2.9 inches. The prevailing winds come from the northwest at eight to 14 miles per hour (mph) during the spring, fall, and winter, and from the south at nine to 10 mph during the summer.

3.2 Land Use

Chambers Works is located in Salem County, NJ on the Delaware River across from the city of Wilmington, DE. The village of Deepwater is adjacent to the Chambers Works. Deepwater is bordered by the town of Carneys Point and the borough of Penns Grove to the north and the town of Pennsville to the south. Chambers Works lies within both Carneys Point and Pennsville Townships. Besides the village of Deepwater, land use directly adjacent to Chamber Works is a mix of recreational (forested/wetlands areas) and light industrial. Figure 3-1 depicts the general land use in the surrounding areas. Figure 3-2 shows generally the wetlands delineation areas within and around the site.

The surrounding area is predominantly rural, with approximately 700 farms. Approximately 43% of the county's land is used for agriculture. In Salem County, 50% of the land is currently farmed, and an additional 25% of the land dedicated to environmental uses such as tidal and freshwater wetlands, marshland, lakes, ponds, flyways, and natural habitats. The developed lands make up only 13% of total land use, and accommodate all types of uses including residential, commercial, and industrial. The Salem River Watershed (117 square miles) and the Delaware River Estuary (23 square miles) cover one-third of Salem County (Rutgers University, 2003).

Pennsville Township is approximately 26 square miles and has the largest population in Salem County. Pennsville is located just south of the Delaware Memorial Bridge at the hub of several important road networks such as State Roads 49 and 130, New Jersey Turnpike (I-95), U.S. Route 40, and I-295. Pennsville is 12 miles from Wilmington, 34 miles from Philadelphia, and 63 miles from Atlantic City. Pennsville is mostly residential with industries/employers including: Atlantic Electric, DuPont Chemicals, Siegfried Pharmaceutical, the Township of Pennsville, and the County of Salem. Pennsville has numerous commercial shopping strips. Pennsville is served by a public water system and sanitary sewer system.

Pennsville has five public school buildings: three elementary, a middle school, and a high school. Almost 75 acres of land in the Township are devoted to school-related activities. Pennsville is served by two volunteer fire companies, located in Pennsville and Deepwater. Much of the land owned by the Township is used for recreational purposes, especially the area known as River View Beach Park. Extensive land along the Delaware River is used for boating, playgrounds, picnics, and other recreational activities.

Figure 3-3 shows the location of several area schools and the nearest hospital, Memorial Hospital of Salem County in relation to the Chambers Works property.

3.3 Demographics

Salem County ranks 10th in the area among all 21 NJ counties, but it is the least populated. Its population of roughly 65,000 is expected to remain stable in the years to come. According to the 2000 U.S. Census, the population of Salem County in 2000 was 64,285. The population of

Carneys Point was 7,684; Penns Grove was 4,886; and Pennsville was 13,194. Carneys Point and Penns Grove experienced a loss in population of about 6% from 1990 to 2000. Salem County experienced a 1.5% loss in population (1,009 persons). Salem County was the only county in NJ to lose population from 1990 to 2000. Historically, the County has had a slow growth rate for the past 50 years, about 30%. Surrounding communities have experienced growth rates in triple digits.

The losses in population can be attributed to a variety of factors, including the downsizing at the DuPont Chambers Works, which may have also caused the relocation of residents to other employment locations, especially for the adjacent communities of Pennsville and Carneys Point. The downsizing may have also contributed to general economic distress in the City of Salem and Borough of Penns Grove.

The county median household income in 2006 was estimated to be $58,164. The median household income for Pennsville was $47,250, while Penns Grove was $26,227 with a percent change of -4.2% and -5.7% adjusted for inflation from 1989, respectively. New Jersey as a state had a median household income of $55,146. The median age in Salem County was 38, which is higher than the NJ median of 36.7 (U.S. Census Bureau, 2006).

The Salem County Labor Force estimates for 2006 show a labor force of approximately 35,000 persons, of which 32,400 are employed and 2,571 are unemployed with an unemployment rate of 7.4% (U.S. Census Bureau, 2006) American Community Survey). According to the 2006 estimates, 30% of the County's jobs were managerial/professional occupations, 27% were sales and office occupations, 15% were production, transportation, and material moving, 17% were service occupations, 11% were construction, extraction, and maintenance, and 0.2% were in farming, fishing, and forestry occupations.

The DuPont Chambers Works facility labor population consists of 1,200 DuPont employees. There are 200 subcontractor personnel working on-site. There are approximately 80 visitors to the site per day to conduct various businesses. The racial makeup of the County is 81.2% white, 14.8% black, and 3.9% Hispanic. The leading ancestry groups in Salem County in decreasing

order are, German, Irish, English, and Italian. These four groups make up 63.2% of the County's population

3.4 Surface Features

The Chambers Works complex is located within the Lowland Subprovince of the Atlantic Coastal Plain physiographic province (Barksdale et al., 1958). The surrounding topography is gently rolling, with elevations from zero to 85 ft NAVD 88. Elevations at the complex are typically approximately 10 ft NAVD 88.

3.5 Surface Water Features

The Delaware River is tidal and brackish at Deepwater and is not a potable water source in the area of the Chamber Works Site, but is a major supplier of potable water to communities north of the area. At the Reedy Point gage the Mean Higher High Tide is 0.875 ft NAVD 88, the Mean Lower Low Tide is -0.905 ft NAVD 88, and Mean Tide Level is -0.036 ft NAVD 88. Chloride concentrations in the Delaware River at Deepwater range from 10 mg/L during spring to 3,200 mg/L during some periods in late summer. Net flow seaward at the Delaware Memorial Bridge averages 18,000 cubic feet per second (cfs) but can exceed 200,000 cfs during floods. The mean tidal discharge is 300,000 cfs on flood and ebb tides. The DuPont site is at river mile 70 from the mouth of the Delaware Bay. At this position, the site lies within the zone of yearly fluctuation of the "salt front", which is the tongue of saline water that moves upriver from the Delaware Bay. The "salt front" is the 250 mg/L chloride concentration contour (DRBC, 2004).

3.6 Regional and Local Geology

Native site soils are of alluvial and palustrine (marsh) origin, but have been substantially modified by landfilling and construction activities. The land along the shoreline has most likely been accreted as point-bar deposits from the Delaware River, or possibly, from over-bank deposition during periodic flooding, which has resulted in the formation of a natural levee. Topographic maps indicate that these sediments formed a strip of land approximately 200 yards wide with an average elevation of five ft above mean sea level along the river's edge. Behind these shoreline deposits, which consist of sands and silty sands, there once existed a tidal marsh consisting of silty clays, with an elevation near sea level. The Chambers Works was gradually enlarged by filling in the marsh areas. Generally, up to a distance of 200 yards from the river's

edge, the soils at sea-level are the naturally occurring marsh deposits, while the soils above sea level are typically fill material (DERS, 1993).

3.7 Regional and Local Hydrogeology

The sedimentary deposits beneath the Chambers Works can be divided into five major sequences (DERS, 1993), as identified in Table 3-2 and Figure 3-4. The uppermost major sequence consists of the A and B aquifer and the A-B and B-C aquitards. The A-B aquitard is discontinuous and thins to zero near the basin complex (DERS, 1993, p. 2 and DERS, 1992b). It has eroded away and thins to zero also in areas where stream channels were once present. The B aquifer consists of sands that are interpreted to be Delaware River alluvium. This unit has an average thickness of 20 ft. The B-C aquitard is a gray to black silt or clay that is thin to absent in the eastern portion of the site and in the vicinity of the settling basins, but well developed along the Delaware River.

The Pleistocene sand and gravel deposits that comprise the A and B aquifers are not widely developed as a groundwater source in Salem County, although yields of up to 1,500 gallons per minute (gpm) have been reported (Rosenau et al, 1969). The deposits, which are hydraulically connected to the Delaware River, form a significant source of recharge to the underlying Potomac-Group aquifer. The geometric mean hydraulic conductivity (K) in the A aquifer is approximately $7x10^{-4}$ centimeters per second (cms), based on the results of 23 slug tests and one pump test. The geometric mean K in the B aquifer is $1x10^{-2}$ cms, based on the results of 59 slug tests and 10 pump tests (ENVIRON 1999, p. 3-8).

The second sedimentary sequence is the C aquifer, which is composed mainly of Pleistocene-age coarse-grained sands and gravels. The third sequence is the C-D aquitard, which is composed of clays and silts of estuarine origin. The fourth sequence is the D aquifer, consisting of coarse-grained sands and gravels. The D unit is valley-fill sediment that is incised in the underlying Potomac Group. The underlying D-E aquitard through the F Aquifer units make up the lowest sedimentary sequence and are the Cretaceous-Age sediments of the Potomac Group. It should be noted that although the surficial aquifers are not an important source of drinking water, the Potomac aquifer is widely used as a drinking water source in southern NJ and DE.

Aquifers A through D are Pleistocene age deposits that unconformably overlie the Cretaceous-Age Potomac group. The E Aquifer at Chambers Works is approximately 100 ft thick and DuPont correlates it to the Potomac Group. NJDEP however, shows that the edge of the Potomac Formation underlies the Pleistocene A-D Aquifers in the northern part of the site, while the Magothy Formation overlies the Potomac Formation in the southern part of the site.

3.7.1 Tidal Influence in the B Aquifer

DuPont produced a study on tidal affects in the B aquifer (ENVIRON, 1999). The IWS has drastically altered the flow direction in the B aquifer so that groundwater flows toward the center of the site. However, the B aquifer is in direct communication with the Delaware River and is influenced by tidal fluctuation. The tidal amplitude within the B aquifer was measured to be a maximum of 3.1 ft in the B-aquifer wells nearest the Delaware River, but the tidal effects are rapidly attenuated with distance from the river. At a distance of 600 ft the tidal fluctuation is approximately 0.5 ft. The maximum distance from the river at which the tidal influence is detectable is 1,000 ft, which is the distance of the AOC 3 area from the river, as shown in Figure 3-5.

3.7.2 Chlorinated Solvents in the B Aquifer

DuPont has delineated both source zones and aqueous-phase plumes of chlorinated solvents in the B Aquifer in the immediate vicinity of OU 1 (DERS, 1995). These dense nonaqueous phase liquids (DNAPLs) include tetrachloroethylene, Freon® 113, and chlorobenzene. Other groundwater contaminants in the B Aquifer include organic lead and arsenic. The groundwater contaminants and aqueous plumes in the B Aquifer have been studied and documented by DuPont RCRA investigations.

3.7.3 Groundwater Extraction Systems

Nearly all of the groundwater extracted from Aquifers B through D at the site is part of an ongoing corrective action to address historical chemical contamination from facility operations. The IWS extracts water primarily from the C and D Aquifers, but also with extraction from the B Aquifer. Additional extraction from the B Aquifer was also captured by the Delaware River Corrective Action Program (DRCAP), C-Basin Well Point System (CBWS), and C landfill wells. It has been reported by DuPont that the DRCAP wells and CBWS no longer exist. In general, the IWS pump and treat system has some influence on the B Aquifer flow direction but

mainly controls flow within the deeper aquifers under Chambers Works. The A aquifer flow direction is primarily controlled by surface drainage (e.g., CDD, ditches), so there is minimal impact on the A aquifer from the pump and treat systems.

Production wells are completed in the E and F Aquifers. These groundwater extraction systems had significant influences on groundwater potentiometric surfaces in these aquifers. It has been reported by DuPont that all the water that is pumped from the extraction/remediation wells is treated at the on-site WWTP prior to discharging the water into the Delaware River. DuPont has also reported that sludge generated by the WWTP is disposed of in an on-site permitted landfill. A review of the different extraction systems is provided below.

Interceptor Well System

The IWS is used to control off-site flow of contaminated groundwater predominantly in the B, C and D Aquifers. The IWS consists of six wells and a stand-by well, and constitutes over 90% of the groundwater extraction at the site in the upper four aquifers. The location of these wells is shown in Figure 3-6. It has been in operation since 1970. Average pumping from the interceptor wells over the last two years has ranged from 1,100 to 2,000 gpm (1.5 to 2.8 million gallons per day).

Delaware River Corrective Action Program (DRCAP)

DRCAP was a series of four extraction wells in the B Aquifer located along the western perimeter of the site. The DRCAP wells were intended to control off-site flow of contaminated groundwater in the B (and possibly A) Aquifer near the Delaware River. Pumping was initiated at the DRCAP wells in July 1989. Total extraction from the DRCAP wells was as much as 10 to 25 gpm in early 1990, but had been reduced to nearly five gpm. The DRCAP wells were shut off in 1998.

C Basin Well Point System

CBWS was a series of 153 well points that was used to control groundwater mounding around the C Basin. It utilized 56 well points along the north side of the basin and 97 well points along the western side of the basin. Pumping at the CBWS began in November 1988. DuPont ceased operation of this system in 1998.

C Landfill Wells

In the C landfill, two pumping wells began operating during the second quarter of 1991. These two wells withdraw water from the B Aquifer as a means of controlling flow in the area. These wells typically pump at a combined rate of 10 gpm or less.

Production Wells

Several production wells actively pump from the E Aquifer. It has been reported by DuPont that two wells are screened in the E Aquifer. One is a production well and the other is a remediation well. Both pump at a rate of 200 gpm, for a total rate of 400 gpm withdrawn from the E Aquifer. Large E Aquifer production wells are also located at nearby Atlantic Electric Company, south of Salem Canal, and appear to influence the E Aquifer flow directions on-site.

3.8 Private Wells

No survey was conducted to ascertain the number of private wells within a one-mile radius of the Chamber Works site. The AOCs under investigation for this RI are located in the western portion of the Chambers Works; thus a one mile radial survey would not reach beyond the property gate. In addition, as discussed earlier in this section, there are several active onsite groundwater pump and treat systems, which work to mitigate the off-site migration of contaminated groundwater. The largest of these systems, the IWS, which has been in operation since 1970, has been used to control off-site flow of contaminated groundwater (predominantly in the B, C, and D Aquifers) since 1970. The operation of the IWS constitutes over 90% of the groundwater extraction flow at the site in the upper four aquifers.

3.9 Ecological Resources

Descriptions of ecological resources that follow are based on a combination of historical documents and qualitative site visits. A review of historical documents was performed for OUs 1 and 3, while a qualitative site visit was conducted at OU 2 in October 2003 to investigate the need for a radiological ecological risk assessment. Available information regarding habitat and ecological receptors is provided below.

3.9.1 Habitats

The former MED production areas consisting of AOC 1 and AOC 2 (OU 1) are completely covered by pavement and devoid of any vegetation. Therefore no suitable habitat exists to attract ecological receptors.

The open portion of the CDD (AOC 3) is approximately 1,600 ft long, and flows eastward from a point west of Kinetic Road and ultimately discharges into Basin B, and thence to the Delaware River. It should be noted that the upper approximately 700 ft of the open CDD has no riparian vegetation or other habitat features that would attract mammals or birds, other than occasional incidental visits.

The lower approximately 900 ft of the CDD presents considerably different habitat. There is considerable streamside vegetation throughout this reach, including wetland vegetation. The CDD in this reach is narrow and relatively deep.

The Building J-26 Area (AOC 5) is completely covered by pavement or buildings and therefore, no suitable habitat exists to attract ecological receptors.

AOC 4, Lagoon A was located in the northern portion of the site, bounded by the Delaware River to the north. The CDD provided the conduit for wastewater discharged from the MED production areas to the lagoon. Settling basins (A and C) within the lagoon are no longer in use and have undergone RCRA closure. Basin A has been stabilized *in situ* and Basin C has been drained and capped. Only a portion of Basin B within the lagoon is in current use. The lower half of Basin B, approximately eight acres, is currently used for facility storm-water collection. There is no surface water present in the northern part of AOC 4 near AOI 1 (DuPont's SWMU 5 Area).

AOC 6 area is bounded by truck maintenance yards, gravel lots, and warehouse area, and is currently used for road way and parking area. Little or no habitat is present in the soil. In AOC 6 there is a ditch which contains water only during storm events.

3.9.2 Ecological Receptors

In the shallower, upper portion of the CDD, numerous small fish were observed that appeared to be mummichog (*Fundulus heteroclitus*), a killifish that is common and abundant in the mid-Atlantic region. No other animals were observed in the upper portion of the CDD, although bird and mammal tracks were noted on the bank of the ditch in one location.

No aquatic organisms could be observed in the lower portion of the CDD due to its depth. However, a number of birds were observed in and near the lower reach. European starlings and mourning doves were common. A belted kingfisher, a northern mockingbird, and an Eastern phoebe were each observed in the riparian vegetation in the lowermost portion of the CDD. Outside of the immediate CDD, but in proximity, one, and possibly two, kestrels were observed. Also, approximately 50 Canada geese were observed swimming in Basin B.

No census has been conducted for animal populations in both the lagoon area and open ditch. However, the areas would provide habitat for mammals and birds tolerant of disturbed environments, such as

- short-tailed shrew (*Blarina brevicauda*)
- Eastern Cotton-tailed Rabbit *(Sylvilagus floridanus*
- white-footed mouse *(Peromyscus leucopus)*
- white-tailed deer (*Odocoileus virginianus*),
- American Robin (*Turdus migratorius*)
- European Starling (*Turnus vulgaris*),

Canada goose (Branta *canadensis*), mallard duck (*Anas platyrhynchos*), and great blue heron (*Ardea herodias*) have been observed in AOC 4. In addition, numerous arthropod species (insects, spiders, etc.) are likely present.

3.9.3 Threatened or Endangered Species

USEPA guidelines advocate the application of professional judgment in selecting appropriate receptors for ecological risk evaluation (USEPA, 1997). Ecologists identify what species and habitats occur or are expected to occur on the site, and delineate generic categories of receptors (plants and animals) expected to be exposed to contaminants. For the DuPont Site, terrestrial and aquatic habitats are present, although they are limited in extent and highly impacted by their urban surroundings.

Special consideration should be given to the possible existence of sensitive environments as described by the Superfund Hazard Ranking System (USEPA, 1997). Rare, threatened, or endangered species, either federal or state, and species of commercial, recreational or other value or importance are given special consideration. The following four threatened species are know to occur in at least one of the Salem County municipalities - Sensitive Joint - Vetch (*Aeschynomene virginica* – Plants); Swamp Pink (*Helonias bullata*- Plants); Bog Turtle (*Clemmys muhlenbergii* - Reptiles); and Bald Eagle (*Haliaeetus leucocephalus* -Birds).

The U.S Fish and Wildlife Service (USDI, 2007) also makes note of the potential presence of the threatened Sensitive Joint - Vetch (*Aeschynomene virginica*). This plant has historically occurred in the vicinity of the Site in freshwater tidal wetlands. Therefore, the Fish and Wildlife Service recommended a survey of any Site tidal wetland areas that may be affected by proposed actions. In addition, there is a peregrine falcon (*Falco peregrinus*) nest site immediately adjacent to the Site. While peregrine falcons were removed from the listing of threatened and endangered species in 1999, they are still protected under the Migratory Bird Treaty Act (16 U.S.C 703-713) and under NJ regulations as a State listed (endangered) species. The State listed endangered plant species Chickasaw plum (*Prunus angustifolia*) is also known to occur in the vicinity of the Site.

4.0 OU 1 INVESTIGATION RESULTS

4.1 Site Characteristics

General site characteristics for the Chambers Works site are presented in Section 3.0; the information provided below is specific to OU 1 surface features, soils and hydrogeology.

4.1.1 Surface Features

OU 1 is located in the northwest portion of the Chambers Works complex (see Figure 1-2). Figure 4-1 presents the OU 1 site layout and topographical features. Currently, AOC 1 is predominantly covered with gravel. The remainder of the AOC is covered by asphalt. The gravel layer is approximately six to eight inches in depth, and covers asphalt and concrete foundations remaining from the Former Building 845. AOC 1 is not actively being used by DuPont. The area is bounded by a wooden trough to the east and northeast. Rail lines are located adjacent to the wooden trough to the east-northeast. The northwest portion of the site is bounded by the portion of the CDD that is an open channel. The west side of AOC 1 is bounded by a slight depression (formerly the open channel of the CDD, now enclosed within two concrete culverts). The south side of the site is bounded by a rail yard. The adjacent land use is industrial. AOC 1 is flat with very limited change in elevation. The wooden trough on the east and depression of the former CDD on the west convey surface water drainage to the open channel portion of the CDD along the northwest corner of the site.

AOC 2 is currently covered with asphalt. Prior to the investigation, the area was being used as a subcontractor trailer and laydown area for equipment. The trailers and equipment from this area were relocated to the E Parking Corral Area prior to the intrusive investigation in the F Parking Corral. The area is bounded to the north by a portion of an open channel drainage ditch, which is part of the CDD. The east portion of the site is bounded by the slight depression (formerly the open channel of the CDD, now enclosed within two concrete culverts). The south side of AOC 2 backs up to Compound Bulk Storage, a former tank storage area. The west portion of the site is next to a stone and asphalt lot. The depression of the former CDD on the east portion of AOC 2, and drainage ditch on the north, convey surface water drainage to the open portion of the CDD. The adjacent land use is industrial. AOC 2 is flat with very limited change in elevation.

4.1.2 Soils

As depicted in the geologic cross section in Figure 4-2, the upper six to eight ft of OU 1 soils consist of construction backfill and rubble. Soil textures are variable but mostly are silt and silty sand. This upper unit corresponds to the A Aquifer. Below eight ft, the silt and clay lenses occur to a depth of approximately 10 ft in the northeastern portion of OU 1, but this unit thins and may not be present in the extreme southwestern portion of OU 1. This depth interval corresponds to the A-B Aquitard. Below 10 ft bgs is a clean, fining-upward sand unit with occasional gravel lenses. This unit extends to a depth of approximately 20 ft bgs and corresponds to the B Aquifer.

The fill material in AOC 1 is covered predominantly by six to eight inches of gravel. Portions of the AOC where former access roads were located, such as along the wooden trough, are covered by asphalt. AOC 2 is capped by asphalt and a gravel sub base. AOC 1 contains the remaining concrete slab on grade and foundations from Former Building 845. Fill soils underlie the building slab and the gravel and asphalt covers encountered in AOC 1. These fill soils are generally mixed with demolition rubble and debris in AOC 2. The demolition fill material in AOC 2 consists of concrete, metallic debris, brick, wood, and miscellaneous debris. The fill also includes the remains of tank and building foundations and slabs on grade of the former buildings of the F Parking Corral Area. The demolition fill layer extends from just below the surface to a general depth of six to eight ft, although rubble was encountered at depths up to 11.5 ft.

An abundance of concrete, rubble, and debris was encountered during the soil investigation of AOC 2. Concrete was anticipated near the surface because of the inferred footprint of demolished Building 708 and the other long rectangular building in the central portion of the F Parking Corral. However, concrete was also encountered at depths ranging from three to seven ft. The debris, assumed to have been generated during the demolition of buildings in the F Parking Corral Area, was encountered at depths ranging from 0.5 to 11.5 ft. The debris included wood fragments, smaller pieces of metallic debris, and rebar. Two test pits were completed within the Former Building 708 Area to further characterize the debris in this area, as discussed in Section 4.2.2.3. Wood and miscellaneous debris were encountered in one test pit, and a concrete slab in the other.

Subsurface debris encountered in AOC 1 was confined to the elevator shaft. Soil borings and subsequent test-pitting operations revealed that the building abandonment process had left the elevator pulley and cable assembly within the shaft, along with an abundance of angle iron and bricks.

4.1.3 Site-Specific Hydrogeology

OU 1 is underlain by the A, B and C aquifers. The A aquifer is composed of fill material and is subject to unconfined, or water table, conditions. Initial investigations in OU 1 revealed an average depth to water of six ft across the site with a northwest gradient. The gradient appears to get steeper along this flow path, which terminates at the Delaware River. Perched water is present with depths varying between two and three ft, which is not unexpected given the heterogeneous nature of fill material and the presence of a clay layer, within the fill, at an average depth of five ft. The B aquifer consists of sands and is interpreted to be Delaware River alluvium. The unit has an average thickness of 20 ft. Beneath the B aquifer is the C aquifer composed primarily of coarse-grained sand and gravel.

Within the Chambers Works site, groundwater has a northeastward flow direction in the B aquifer. As previously discussed, the most prominent B aquifer feature is a cone of depression caused by the interceptor well system, installed in the 1970s (DERS 1993). Contour maps of organic and metal contaminants in the B aquifer indicate that the groundwater flow direction was probably to the north-northwest before the commencement of pumping(DERS, 1995).

Study Area Investigation

This section presents detailed information for the soil and groundwater investigations conducted for OU 1. General information regarding investigative techniques, sampling methodologies and analytical requirements can be found in Section 2.0.

4.1.4 AOC 1, Former Building 845 Area

4.1.4.1 Soil and Vadose Zone Investigations

A total of 56 borings (43 soil locations and 13 test pit borings) were completed in AOC 1, as shown on Figures 4-3 and 4-4. The initial characterization for the Former Building 845 Area investigation included 24 grid sampling locations and nine biased sampling locations (labeled as "BH" locations on Figure 4-3), rather than the five originally proposed. Five of the biased samples were added based on the GWS results, while four were added based on historical

locations of potentially higher activity or to provide further characterization of an area. The soil borings were advanced using Geoprobe techniques to a depth of 15 ft bgs with the exception of the seven locations where concrete coring was conducted and locations within the wooden trough (1BH003, 1BH011, 1BH027, and 1BH029). Soil borings conducted through the wooden trough were advanced using Geoprobe techniques to an average depth of 10 ft bgs. The concrete coring investigation is discussed in Subsection 4.2.1.2. Split-spoon sampling methods using a hollow-stem auger were used at three of the concrete locations (1BH005, 1BH010, and 1BH022), as discussed in Section 4.2.1.2, while soil at one location (1BH036) was collected with a shovel and stainless-steel trowel.

The surface grab sample for 1BH036 was taken adjacent to two biased sampling points that indicated elevated radioactivity (1BH010 and 1BH033). During the collection of the grab sample, a solid yellow material was encountered within the first foot of soil below the 12 to 18 inch gravel layer. To further delineate and characterize this material and the elevated readings in this localized area, a test pit program was conducted as described in Subsection 4.2.1.3. The results from the associated test pit borings are discussed in that subsection.

Samples referred to as surface soils with a depth of zero to 1.5 ft correlate to the top of the soil surface below the 12 to 18 inch gravel cover that is present over most of the Former Building 845 Area. This cover was removed at each location prior to sampling; therefore, the top of the soil surface was referenced as zero ft.

An additional five Geoprobe borings (labeled "SB" on Figure 4-3) were installed in July 2007 to gather data in support of the BRA as well as to establish the relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations. Borings were installed to a maximum depth of 10 ft.

During the CPT soil logging activities in AOC 3, a location in AOC 1 (1-CPT-06) was sampled and analyzed to confirm the response of the in-situ gamma probe, as requested by the USACE.

4.1.4.2 Concrete Investigation

The Former Building 845 Area investigation included concrete coring at seven locations with subsurface sampling being conducted below the concrete at locations 1BH005, 1BH008,

1BH009, 1BH010, 1BH015, 1BH022, and 1BH033 as shown in Figure 4-3. Sampling methodology is presented in Section 2.2.6. Six concrete sample locations were originally proposed and one biased sample location (1BH033) was added adjacent to an existing concrete coring location (1BH010) based upon field instrument readings showing increased radioactivity. All seven concrete samples were collected within the footprint of the Former Building 845. The existing concrete floor slab on grade or immediately adjacent to the Former Building 845 remains intact and just below the 12 to 18 inch gravel layer. Following demolition of Building 845, the gravel layer was installed over the concrete slab. A different-colored stone that is lighter in color than the surrounding darker gravel was used to distinguish the limits of the concrete slab.

Split-spoon techniques were used at three locations (1BH005, 1BH010, and 1BH022) because the auger rig was on-site for the elevator shaft borings, and the Geoprobe rig had not yet been mobilized to the site. Additional soil samples were collected depending on the results of the on-site gamma spectroscopy laboratory results for the first soil sample. If the ISV of 14 pCi/g was exceeded in this sample, additional soil samples were collected until the concentration of U-238 was below the ISV. Generally, the boreholes at the concrete core locations were advanced to a depth of approximately five ft below the concrete surface.

Another component of the concrete investigation was to assess the contamination present in the elevator shaft. The elevator shaft was reportedly filled in with sand when Building 845 was dismantled. The elevator shaft sampling was attempted initially by hollow-stem augering down through the elevator shaft. However, a large amount of debris (metal, brick, concrete rubble, and wood) precluded the advancement of the augers past 3.5 ft. It was decided to further investigate the elevator shaft by accessing the contents of the elevator shaft with excavation equipment. This investigation is discussed below.

4.1.4.3 Test Pit Investigation

The test pit investigation in the Former Building 845 Area included excavation to the base of the elevator shaft and further delineation of the Uranium Oxide Area. This was a localized area of high radiological activity identified to the east of Building 845 during the initial gamma walkover scans. The methodology used for the test pits is presented in Section 2.2.5.

Elevator Shaft Test Pit

In order to access the elevator shaft foundation, it was necessary to first remove the large amounts of subsurface debris within the elevator shaft with excavation equipment. A temporary composite liner system, composed of a geotextile over and underlying a PVC geomembrane, was utilized for the placement of the excavated elevator shaft contents. The approach is documented in a Technical Memorandum prepared by WESTON (WESTON, 2002c). Once all the contents were removed, a substantial amount of water remained within the shaft. To mitigate potential migration of contaminants below the concrete floor once it was breached, the water in the shaft was removed to the extent possible with a trash pump and placed into 55 gallon drums. A grab sample of this water was collected and sent to the analytical laboratory for IDW characterization (See Appendix D).

A concrete punch attachment on the excavator was used to break up the base of the elevator shaft. The excavator bucket was decontaminated between each phase of the operation to prevent cross-contamination. Pieces of the broken concrete and underlying soil were brought to the surface with the excavator bucket. Three concrete samples were sent to the off-site laboratory for radiological analysis. Three separate soil samples were collected just below the concrete slab and analyzed by the on-site gamma spectroscopy laboratory. One of these three soil samples was sent to the off-site radiological laboratory for confirmation using the same analyses. The analytical results of the soil and concrete samples and the field instrument direct readings and wipe samples collected from the debris are presented in Section 4.3.

The excavated contents were backfilled into the elevator shaft along with the temporary composite liner system. The soil and stone cover was placed over this area at the end of the investigation. Figure 4-4 shows the location of the elevator shaft (identified as 1TP025).

Uranium Oxide Area Test Pits

The localized area of higher radiological activity, known as the Uranium Oxide Area, was initially identified after the stone and soil cover were removed from concrete locations 1BH010 (grid location) and 1BH033 (biased location), and initial scans of the surface with the field radiological instruments indicated high activity. The biased sample location 1BH033 (concrete core) was selected based on previous investigation results (BNI, 1985), which indicated higher

concentrations of uranium in the soil and groundwater in this area on the east side of Former Building 845. Elevated readings on the radiological field instrument (Ludlum Model 19 Micro-R Meter) of 1000 µR/hr (one mR/hr) were recorded initially after the stone cover was removed to access location 1BH033. In addition, three grab samples were collected at 1BH036, based on elevated surface scan readings in the area. The first sample was composed of mainly the yellow material, the second and third sample were predominantly soil mixed with this material. All three samples were sent to the on-site gamma spectroscopy laboratory, and two were also sent to the off-site radiological laboratory for gamma and alpha spectroscopy analysis. Samples were also sent for batch desorption testing and XRD/SEM analysis.

As presented in Table 4-2, the total uranium results for the grab samples at 1BH036 from the on-site laboratory gamma spectroscopy analysis significantly exceeded the ISV of 14 pCi/g. The concentration in the first sample composed primarily of the yellow material and the two soil and yellow material mixtures were 51,454 pCi/g (1BH036-SS-05-0-1), 12,256 pCi/g (1BH036-SS-05-0-2), and 11,360 pCi/g (1BH036-SS-05-0-3). The corresponding offsite laboratory gamma spectroscopy results for total uranium were 99,043 pCi/g and 19,041 pCi/g in samples 1BH036-SS-05-0-1 and 1BH036-SS-05-0-2, respectively. Based on these sample results it was determined in consultation with USACE that additional delineation would be required as part of the test pit program. The approach for this test pit program is documented in a Technical Memorandum prepared by WESTON (WESTON, 2002c).

The first portion of the Uranium Oxide Area to be investigated was the area immediately around 1BH036. The yellow material and underlying soils were exposed and were surveyed with the appropriate radiological instrumentation. Transects were established from this area radiating away from the former building foundation (toward the east in the area not covered by the building concrete pad). From the initial test pit location at 1BH036, test pits were then completed along transects approximately 10 to 15 ft from this initial location, and then approximately five to 10 ft from the first locations. The program, therefore, consisted of a series of test pits along transects surrounding 1BH036 as shown in Figure 4-4. A total of 24 test pits were completed.

The test pits were completed utilizing the methodology presented in Section 2.2.5. The Micro-R meter was the primary field instrument used to identify higher activity. The approach used to

collect soil samples from the test pits for further analysis was an action level of 20 µR/hr, which corresponded to background levels. The reading was based on a composite scan of the test pit sidewalls. Samples were collected from the bottom of the test pits (generally one to 1.5 ft bgs), where the instrument readings were above 20 µR/hr, and sent to the on-site gamma spectroscopy laboratory for analysis. The exceptions were at test pits 1TP010, 1TP019, and 1TP020, where concrete was encountered below the gravel layer. Twelve samples were collected for analysis at the on-site laboratory. Three samples were also selected for off-site gamma spectroscopy and two for alpha spectroscopy analysis. The results of this sampling are discussed in Section 4.3.3.4.

4.1.5 AOC 2, F Parking Corral

4.1.5.1 Soil and Vadose Zone Investigations

A total of 63 soil borings were completed in AOC 2, as shown in Figure 4-5. The initial F Parking Corral investigation included 38 grid sampling locations and five biased sampling locations (labeled as "BH" locations on Figure 4-5). The biased sampling locations were based on either the GWS results, historical locations of potentially higher activity, or to provide further characterization of an area. The soil borings were advanced using Geoprobe techniques to a depth of 15 ft bgs with the exception of the three locations where concrete coring was conducted (2BH015R, 2BH024 and 2BH032) and one location (2BH043) where known utilities existed. The concrete/debris layer was encountered at varying depths throughout the F Parking Corral. The concrete coring investigation is discussed further in Subsection 4.2.2.2. An additional 15 borings were drilled in AOC 2 for monitoring well installation (labeled "MW" on Figure 4-5) while five Geoprobe borings (labeled "SB" on Figure 4-5) were installed in July 2007 to gather data in support of the BRA as well as to establish the relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations. The Geoprobe borings were installed to a maximum depth of 10 ft bgs.

There were numerous Geoprobe sampling locations at which refusal was encountered. Geoprobe refusal was most often caused by concrete, concrete rubble, or metallic and wood debris. Further discussion of the site-specific subsurface profile is presented in Section 4.1.2. Because of the unexpected extensive fill material at depth in the F Parking Corral Area, a modified approach was developed for sampling in this AOC. Using the geophysical information obtained from the

EM surveys, the soil boring program was modified so that locations where extensive fill was not evident were advanced first. This was followed by locations where offsetting within 10 to 15 ft of the original grid point would likely prove successful with the Geoprobe. Ten locations were identified, most within the Former Building 708 footprint, where continuous concrete, concrete rubble, or other debris was evident for a radius of 15 ft or more around the original location. At these locations, a hollow-stem auger rig was used to advance these borings. Soil samples were collected using split-spoon techniques in the following nine boreholes: 2BH01SR, 2BH019, 2BH019R, 2BH023R, 2BH034, 2BH026, 2BH027, 2BH031R, and 2BH033. Samples referred to as surface soils with a depth of zero to 1.5 ft correlate to the top of the soil surface below the approximately six inch asphalt and stone subbase cover over the F Parking Corral.

4.1.5.2 Concrete Investigation

The F Parking Corral investigation included concrete core sampling at three locations (2BH015R, 2BH024, and 2BH032) as shown in Figure 4-5. Unlike the Former Building 845 Area, the concrete slabs and foundations in the F Parking Corral were not present as a continuous slab below a gravel cover; they were part of a rubble and debris layer encountered from just below the surface from six to eight ft. The concrete/debris layer was encountered at varying subsurface depths throughout the F Parking Corral. The concrete was encountered at 6.5 ft at 2BH015R, six ft at 2BH024, and at seven ft at 2BH032. The depth at which the concrete was encountered precluded the use of the concrete coring machine. Initially, eight locations were designated for alternative sampling techniques using the hollow-stem auger rig to advance the borehole, split-spoon sampling methods to collect soil samples, and where possible, NX core drilling to obtain concrete samples. Based on actual subsurface conditions encountered, only three locations were determined feasible for concrete sampling using the NX core bit through the hollow-stem augers. The recovered concrete cores varied in total length, but were generally less than one foot in length. Four concrete samples were collected. One concrete sample each from 2BH015R and 2BH024, and two cores from 2BH032 were sent for off-site radiological analysis. Samples of the soil fill material above and below these concrete samples were collected using split-spoon sampling techniques and characterized using the soil screening and off-site laboratory analysis methods discussed previously.

4.1.5.3 Test Pit Investigation

Two test pits were completed in the area of the Former Building 708 in the F Parking Corral as shown in Figure 4-6. Results from the Geoprobe and auger sampling indicated radiological activity above the ISV in this area. The two test pits (2TP001 and 2TP002) were located near boreholes where the following occurred:

- Building debris was encountered.
- The location was within/adjacent to the area of the Former Building 708, which contained high uranium levels in soil based on the on-site gamma spectroscopy laboratory and on historical results (BNI, 1985).
- Material above and below the debris had been characterized.
- The debris layer had not been characterized because a split-spoon or Geoprobe sample was not possible; and based on the geophysical survey, building debris is suspected.
- The location was not near suspected or known utilities.

The methodology for test pit excavation is presented in Section 2.2.5. Test pit 2TP001 was excavated to the debris layer approximately three ft deep. Test pit 2TP002 was not completed to the debris layer because of the presence of the concrete foundation. A direct reading of the exposed concrete slab was taken with the field instrument. No wipe samples were taken because of the miscellaneous nature of the debris. The results of the field instrument from both test pits will be discussed in Section 4.3. Test pit logs are provided in Appendix C-4.

4.1.6 Groundwater Investigations

The investigation of groundwater conditions at OU 1 was conducted in an iterative approach. The initial characterization was performed during the soil and vadose zone investigations specific to each AOC and consisted of obtaining samples via temporary piezometers to identify areas potentially contaminated above the ISV by MED-related radiological compounds. The subsequent investigation centered on monitoring well installations to further evaluate the potentially contaminated areas and aquifer flow gradients within OU 1 as a whole. Details of the sampling efforts for groundwater investigations are presented below.

4.1.6.1 Initial Groundwater Characterization

AOC *1*

Groundwater samples were collected from temporary piezometers installed within 21 boreholes completed at the grid and biased soil sampling points in the Former Building 845 Area. The piezometers installed in AOC 1 had five ft screened sections, which allowed sampling between 10 and 15 ft bgs. The groundwater collected from the temporary piezometers represented a composite sample of the borehole and may have contained perched water that was observed closer to the ground surface at many borehole locations.

Groundwater samples were not collected at the six grid locations where the concrete slab was present and at one biased concrete sampling location. No temporary piezometers were installed through the concrete core locations within the Former Building 845 footprint because groundwater was not encountered within the depth of these shallow boreholes. The boreholes at the concrete core locations were typically five to six ft in depth. At this final depth, the soil concentration was below the ISV of 14 pCi/g based on the results of the on-site gamma spectroscopy laboratory.

Groundwater samples were collected in four of the nine biased sampling locations. Temporary piezometers were not installed in two of the locations, 1BH027 and 1BH029, which are located in the wooden trough. Groundwater samples were not collected at these locations because of the potential influence of mixture with the surface water in the trough and the proximity of these boreholes to other locations. Locations 1BH026 and 1BH028 were also in proximity to each other so a piezometer was installed only at 1BH026. Location 1BH033 was placed at the concrete slab and location 1BH036 was a surface soil sample location only, so no temporary piezometers were installed at these points.

AOC 2

Samples were collected from temporary piezometers installed within 34 boreholes completed at the grid and biased soil sampling points in the F Parking Corral Area. The piezometers installed in AOC 2 used 10 ft screened sections, which allowed sampling between five and 15 ft bgs. Groundwater samples were not collected at grid locations 2BH015, 2BH024, and 2BH032,

where concrete coring was conducted, because of the difficulty of installing a temporary piezometer through the cored hole at depth. At grid location 2BH023, concrete was encountered at a depth of 6.5 ft with the Geoprobe. This location was not investigated past this depth based on the low radiological activity indicated by the field instruments and confirmed by the on-site screening laboratory. Temporary piezometers were also not installed at grid location 2BH002, because of the proximity to locations 2BH001 and 2BH003, which were anticipated to provide representative coverage of groundwater quality in this area. Similarly, no temporary piezometer was installed at grid location 2BH027, because of the proximity of samples collected at 2BH026 and 2BH019. A temporary piezometer was installed at 2BH009, but sufficient sample volume could not be recovered from this location.

Groundwater samples from temporary piezometers were collected in four (2BH039, 2BH040, 2BH041, and 2BH042) of the six biased sampling locations. A temporary piezometer was not installed in biased location 2BH038 due to the proximity to location 2BH018, from which a groundwater sample was collected. Extensive debris in this area also made temporary well point installation difficult. Biased location 2BH043 did not have a temporary well installed because this location is directly over a subsurface utility, limiting the depth of investigation to 1.5 ft bgs.

4.1.6.2 Groundwater Investigations

A total of 26 monitor wells were installed in a phased approach to facilitate the investigation of groundwater in OU 1. Eighteen wells were installed in September 2004 (2-MW-1 through 1-MW-18), and an additional eight wells (2-MW-19 through 2-MW-26) were installed between July and August, 2005. Two wells (3-MW-13 and 3-MW-14) were installed in AOC 3 (CDD) within OU 2; they have been incorporated into the OU 1 groundwater discussion to provide a comprehensive view of groundwater characteristics in the area. Twelve of the 13 monitoring wells placed in the A aquifer were installed to approximate total depths of nine to 11 ft bgs. One well (2-MW-19A) was installed to an approximate depth of six ft bgs. Exact depths in A aquifer wells varied slightly depending on local changes in aquitard elevation. Eleven of the 12 monitoring wells placed in the B Aquifer were installed to approximate total depths of 20 to 23 ft bgs. Monitoring well 2-MW-03B was installed to a depth of 17 ft bgs. One well (2-MW-25C) was installed in the C aquifer to an approximate depth of 37 ft bgs to assist in the delineation of vertical extent of groundwater contamination. Section 2.5.3 provides detailed information on

well installation and development methodology. Table 4-1 summarizes the rationale supporting the proposed well locations. Final monitoring well locations are depicted in Figure 4-7. These wells were used to obtain representative groundwater samples. Water samples were obtained from all three aquifers to more adequately determine both the potential vertical migration of uranium in groundwater and the potential nature and extent of uranium impact at the Uranium Oxide Area (AOC 1), Elevator Shaft Area (AOC 1), the Building 708 Area (AOC 2), and the CDD (AOC 3). Samples were also collected for metals and organics in support of the BRA. In addition, the wells were used to identify local flow paths, which could not be adequately determined from the existing widely-spaced wells. The analytical program for groundwater samples was consistent with the methods presented in Section 2.0. The results of the groundwater sampling program are presented in Section 4.3.4.5

A baseline background well-pair (1-MW-17B and 1-MW-18A) was installed during the initial groundwater investigation in a hydraulically upgradient position to source area wells (as shown on Figure 4-7). These "background" condition wells were used to establish the baseline groundwater flow conditions and initial groundwater quality data within OU 1. The location of this pair of wells was selected based on:

1) Current conceptual site model of groundwater flow directions in the A and B Aquifers;
2) Comparatively low radiochemical concentrations previously observed in this area; and
3) Location is the furthest upgradient position from the potentially contaminated area within the operable unit.

4.2 Nature and Extent of Contamination

4.2.1 AOC 1, Former Building 845 Area

4.2.1.1 Source Zones

As described in Subsection 1.2.2.2, the DuPont MED contracts that were associated with Building 845 and the area defined as AOC 1 included Project 9595 – Contract W-74120-Eng 2 and Project 9803 - Contract W-7412-Eng 22. The documented processes and the structures associated with these contracts were shown in Figure 1-3 and Figure 1-7, respectively.

Under contract W-7412-Eng 2, n-perfluoroheptane was produced in Process Buildings A and B shown to the southwest of Former Building 845. Results of the EM-61 geophysical survey

indicate a large anomaly in the area that corresponds to the approximate location of Building A as shown on the historical map presented in Figure 1-7.

Contract W-7412-Eng 22 involved Buildings 101 and 102 (see Figure 1-7), which occupied a 5.3 acre area and ultimately became Building 845. Under this contract, uranium was recovered from scrap and by-products of other processes in the manufacture of uranium by converting uranium metal sludges, uranium metal dross, and slag from green salt/magnesium reaction to uranium peroxide dihydrate ($UO_4 \bullet 2H_2O$), which in turn was converted to black oxide.

During the execution of this contract, 5,486 tons of scrap material were converted to 982 tons of black oxide. Potential source areas of radiological contamination are therefore associated with residual material from operations within and materials handling adjacent to the Former Building 845. Results of previous historical sampling indicated higher radiological activity in several concrete samples from the existing slab on grade of the Former Building 845, and in soils and groundwater in the area east of the Former Building 845. A cluster of higher uranium activity (>300 pCi/g) in soils was reported in this localized area on the eastern side of the building. Possible residual uranium contamination is also indicated along the wooden trough, which was reported to have received process waters from Building 845 based on the historical soil results.

Potential source areas identified during the historical records review process include the footprint of Former Building 845 and the adjacent area to the east near the loading dock. This area is referred to as the Uranium Oxide Area. Potential areas of residual contamination were identified to include the wooden trough and the area where it discharges into the CDD.

4.2.1.2 Soils and Vadose Zone, AOC 1

A total of 56 borings were completed in AOC 1, which included the soils and concrete (43 borings) and test pit locations (13 borings). One hundred and thirty soil samples, seven concrete samples and 17 test pit samples, plus duplicates and third-party splits were collected from these borings. One hundred eleven soil samples were analyzed in the onsite laboratory for total uranium via gamma spectroscopy. Eighty nine samples were shipped to the offsite laboratory for total uranium via gamma spectroscopy and 10 were analyzed offsite via alpha spectroscopy. Ninety-four samples were analyzed for Th-234 and U-235 (gamma spectroscopy); 33 for U-235

(alpha spectroscopy), and 33 for both U-234 and U-238 (alpha spectroscopy). Twenty-one samples were analyzed for Th-230 and 15 for Ra-226 (both alpha spectroscopy). Chemical constituents (TAL metals, VOCs and SVOCs) were also analyzed in a subset of 18 soil samples from AOC 1 in support of the BRA.

The complete database of analytical results for soils and concrete, including QA samples, is provided in Appendix F.

4.2.1.2.1 Radiological Constituents

Uranium

As discussed in Section 1.0, MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny (e.g., Th-234). Natural uranium consists of these three isotopes at the following activity fractions: 48.3% U-234, 3.4% U-235, and 48.3% U-238, while total uranium is the sum of all three isotopes. If the uranium is in a secular equilibrium condition, as displayed by the equal U-234 and U-238 activities above, total uranium may be estimated by measuring U-238 and multiplying the result by 2.1. Using gamma spectroscopy, U-238 is reported via its decay daughter Th-234 (and converted to total uranium using the multiplier above for direct comparison with the ISV of 14 pCi/g). The calculated total uranium value was used to define the extent of soil potentially contaminated above the ISV, as discussed below. Analytical results for total uranium from both the onsite and offsite laboratories are presented in Table 4-2. The maximum concentration reported for any sample location (onsite or offsite analysis, gamma or alpha spectroscopy) is presented in the text and depicted on the figures showing total uranium results. A brief summary of the isotopic U and Th-234 results is also provided in this section, while the analytical results are presented along with analytical data results for the other eligible radiological contaminants Ra-226 and Th-230. This data evaluation process was used throughout Sections 4, 5, and 6 for presentation of radiological soils data.

Thirty of the Th-234 samples were non-detect (32%). Detectable concentrations ranged from 0.96 pCi/g to 327.3 pCi/g. Uranium-234 and U-238 were reported in all samples, with concentration ranges between 0.87 pCi/g and 347 pCi/g (U-234) and 0.69 pCi/g and 340 pCi/g (U-238). The U-235 alpha spectroscopy samples were between 0.14 pCi/g and 21.45 pCi/g.

Sixty-four percent (60 of the 94 samples) were reported as non-detects for the U-235 gamma spectroscopy samples, while detected concentrations ranged from 0.19 pCi/g to 22.81pCi/g. The maximum concentrations of each of these isotopes were detected in one of the same sample locations (1BH034) for which total uranium above the ISV was detected as discussed below.

Of the 130 soil samples analyzed for total uranium by onsite or offsite gamma spectroscopy, a total of 31 samples (24%) contained total uranium concentrations that exceeded the ISV of 14 pCi/g. For the basis of defining extent of potential contamination, the data is presented against the ISV since it was the screening threshold used during the course of field work.

Table 4-2 presents the analytical data for total uranium in soils within AOC 1. The results of the GWS in OU 1 (AOCs 1 and 2) are shown in Figure 4-8. Distribution of the total uranium concentrations in soils in AOC 1 is presented in Figure 4-9. As previously noted the maximum reported result from either the onsite or offsite laboratory is shown at each sample location with the corresponding depth information. Figure 4-10 presents a 2-dimensional cross sectional view showing the vertical depth of uranium contamination above the ISV. The horizontal and vertical extent of contamination is further discussed below.

Horizontal Extent of Uranium Contamination

In AOC 1, the GWS encompassed the accessible areas within the boundaries of the AOC. The only areas not incorporated were ones inaccessible at the time of the survey due to standing water greater than three inches in depth (near the western boundary) and stacked railroad ties. A total of 3.17 acres was surveyed within this AOC. As depicted on Figure 4-8, the majority of AOC 1 is within a Z-Score of one, indicating little variability of radiological constituents across the surface of the AOC. There were five areas within AOC 1 exhibiting Z-Scores above three. The regions of highest surface gamma activity were associated with the wooden trough and drainage ditch, with three of the five areas located at the intersection of the wooden trough with the CDD (northern section of AOC 1). Boreholes 1BH025, 1BH026, 1BH027, 1BH028 and 1BH029 were installed within these five areas to further investigate the source of the elevated gamma measurements.

Vertical Extent of Uranium Contamination

The 23 borehole locations where the ISV for total uranium was exceeded were limited to specific areas of AOC 1 as follows:

- Wooden trough: 1BH003; 1BH025;1BH027, and 1BH029
- Uranium Oxide Area: 1BH034 ,1BH036, 1-SB-01 and 1-MW-08
- Central Drainage Ditch: 1BH001, 1BH002, 1BH018, 1BH026, 1CPT-06 and 1-MW-17
- East of former building: 1BH016,1BH035 and 1-SB-02
- West of former building: 1BH014
- Within footprint of former building: 1-SB-03; 1-SB-04; 1-SB-05; 1BH009 and 1BH010.

With the exception of location 1-MW-17, the CDD and wooden trough soil borings as well as the borings located east and west of the former building exhibited very shallow soil contamination (limited to a depth of two ft bgs). Potential soil contamination above the ISV in the northern portion of AOC 1 was located to depths of 1.5 ft bgs and ranged from 85 pCi/g (1BH027-SS-000-00) in the wooden trough to 127 pCi/g (1BH002-SS-000-0) in the CDD area. Of the three borings east of the former building, the maximum concentration was reported as 104 pCi/g at 1.5 ft bgs (1BH035-SS-000-0). This location is adjacent to the Uranium Oxide Area. The one boring to the west of the former building contained a maximum total uranium concentration of 27 pCi/g at 1.5 ft bgs (1BH014-SS-000-0). In the southwestern portion of AOC 1 along the CDD, boring 1BH018 was potentially contaminated above the ISV (149 pCi/g) from the surface to a depth of two ft bgs (1BH018-02 (zero to two ft)). In contrast, sample 1-MW-17-B-P-01, located just east of 1BH018 in the CDD area had a reported concentration of 46 pCi/g at the discrete 5.5 ft depth. The uranium concentrations above the ISV at these two locations may be the result of residual contamination from the CDD or from activities related to a former storage shed located in this area.

Soils beneath the building footprint exhibited exceedances of the ISV at depths up to four ft bgs. Soil boring 1BH009 contained 579 pCi/g (1BH009-SS-000-0) total uranium at the 1.5 ft depth. The associated concrete sample for 1BH0009 did not exceed the ISV, nor did any subsurface soil samples from this location. Boring 1-SB-04 was also located in the western portion of the building and contained total uranium concentration of 46 pCi/g at the 1.5 ft bgs depth. Since boreholes 1BH009 and 1-SB-04 are located in the western portion of the former building,

constructed after the MED activities had ended, it is likely that surface soil contamination was present at this location prior to the construction of the building addition. Boring 1-SB-05 contained 545 pCi/g (1-SB-05-BS-P-01) total uranium at the four ft depth. This location was also potentially contaminated above the ISV in the first one ft interval.

The Uranium Oxide Area was potentially contaminated above the ISV to depths of 4.5 ft. Excluding the surface grab samples from 1BH036 (99,043 pCi/g), the highest levels of total uranium were detected at the 1.5 ft depth, with concentrations decreasing with depth. Boring 1BH034 was potentially contaminated above the ISV from the surface to a total depth of four ft. The maximum total uranium concentration at this location was 677 pCi/g (1BH034-SS-000-0) at the 1.5 ft interval. In contrast, boring 1-SB-01 was potentially contaminated at the discrete three ft interval (414 pCi/g in 1-SB-01-BS-P-02), while boring 1-MW-08 exceeded the ISV in the 4.5 ft interval only (270 pCi/g in 1-MW-08-B-P-01).

The horizontal and vertical boundaries of potential uranium contamination presented in Figure 4-9 and Figure 4-10 for the Former Building 845 Area encompass the potential source area to the east of the former building (Uranium Oxide Area including the area between the wooden trough and the east side of the building), and potential residual contamination areas within and adjacent to the wooden trough and the CDD. Areas within the building footprint and to the west of the building are also within this area of soils that exceed the ISV. The outer grid samples collected during the RI defined the horizontal extent of potential contamination along the southern perimeter of the Former Building 845 Area. Delineation of contamination to the west of 1BH018 was completed with boreholes installed as part of the RI at the F Parking Corral Area (AOC 2).

The biased sample locations at the middle and northern sections of the wooden trough (1BH027, 1BH003, and 1BH029), where the ISV was exceeded in the surface soil samples were further delineated by additional sample locations installed under the OU 2 field effort to define the horizontal extent of residual contamination along this ditch. Migration pathways may include migration of contaminated sediments farther downstream and migration of sediments from the ditch to adjacent soils during storm events or as a result of past industrial activities (spillage, soil

disturbance, fill activity, etc.). Further discussion of a potential downstream pathways is presented in Section 7.0 for OU 2.

The wooden trough discharges into the CDD at the north end of AOC 1. Water levels were observed to fluctuate during the field activities, suggesting possible past flooding during storm events. Boreholes to the west of the wooden trough do not suggest impact from flooding or localized spillage.

The exceedance of the ISV in the surface soil sample at biased borehole location 1BH026 located on the bank of the CDD, was also further delineated by the sample locations installed during the OU 2 field effort to further define the residual contamination in this area. Contamination is likely to be confined to the area immediately adjacent to the CDD within the zone impacted by flood events. It is important to note that the bottom of the channel is not lined, but the upper side slope of the channel and the surrounding area adjacent to the CDD within OU 1 are covered by asphalt. The existing asphalt cover will limit sediment migration and deposition where present.

In boreholes 1BH034, 1BH018, 1-SB-04 and 1-SB-05, analytical results indicated limited downward migration of uranium contamination, in that contamination was contained within the first five ft below the surface of the soil below the gravel cover. Since the groundwater table was typically encountered at six to eight ft bgs, total uranium activity exceeding the ISV was not within the saturated zone soils, with the exception of the elevator shaft.
The Sitewide RI results appear to be consistent with those from the 1983 BNI study (BNI, 1985). The previous study showed that the areas of highest uranium activity (U-238) were associated with the identified Uranium Oxide Area (>300 pCi/g) located to the east of Former Building 845. The eastern part of Former Building 845 and the area from the north end to the midsection of the building east to the wooden trough were identified as containing elevated activity.

The vertical extent of uranium contamination reported in the BNI study report (BNI, 1985) for the Former Building 845 Area is also consistent with the OU 1 RI results. Vertical extent of contamination was reported to be limited to the upper one to three ft of soil. Additionally, the previous study results showed levels of uranium (U-238) between 30 and 300 pCi/g at sample

locations along the wooden trough. The highest concentrations detected in the wooden trough during this investigation were found in the northern end of the wooden trough where it meets the CDD. A soil sample at 1BH027 (86 pCi/g) and a sediment sample collected during the OU 2 investigation at 2-SB-04 (98 pCi/g).

Other Radiological Constituents

Th-230 was detected in three of the same samples containing elevated concentrations of total uranium (i.e. above the ISV of 14 pCi/g). Sample 1-BH036-BS-005-0 contained the maximum concentration of Th-230 via alpha spectroscopy (64 pCi/g). Elevated concentrations of Th-230 were also reported in samples 1-SB-01-BS-P-02 and 1-BH009-BS-000-0. The remaining soil sample concentrations for Th-230 ranged from 0.38 pCi/g to 1.83 pCi/g. The concentrations of Ra-226 ranged from 0.34 pCi/g to 2.26 pCi/g in soil samples. The maximum Ra-226 concentration (2.26 pCi/g) was detected in sample 1-MW-22-B-P-01. Table 4-3 presents the analytical results for all radiological isotopic samples, while Figure 4-11 shows the distribution of results across AOC 1.

4.2.1.2.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 Preliminary Remediation Goal (PRGs) for residential soil. These PRGs were chosen for use because they represent the most recently updated human health screening values and in most instances are more conservative than the values published in the State of NJ standards. Full data presentations are presented in Appendix F. Table 4-4 presents a summary of those metal constituents exceeding a respective PRG; Table 4-5 presents an exceedance summary for VOCs and SVOCs; and Table 4-6 presents a summary of polycyclic aromatic hydrocarbon (PAH), PCB and pesticide compounds. Analytical results for chemical constituents are compared to background constituent concentrations in the background screening step of the BRA (CABRERA 2011b). The reader is referred to Appendix B of the BRA, Tables B-1-2 through B-1-6 (Surface Soil) and Tables B-2-2 through B-2-7 (All Depth Soil).

Metals

Out of 18 samples, thallium was detected in only one while antimony, beryllium, cadmium, selenium and silver were detected in five to eight samples. The remaining metals were detected in over 80% of the samples. Five metals have concentrations that exceeded the respective PRG. In general, the highest metals concentrations were detected in shallow soils (i.e., less than three ft in depth).

As shown in Table 4-4, antimony was reported above the PRG in one sample; while chromium, iron and lead exceeded the PRGs in three samples each. In contrast, arsenic was reported above the PRG in 17 of the 18 samples. The maximum antimony value of 56 milligrams per kilogram (mg/kg) (PRG of 31.3 mg/kg) was observed in sample 1-SB-01-BS-P-02. Sample 1-SB-02-BS-P-01 contained the maximum values of chromium, lead and iron. Chromium was reported above the PRG of 30.1 mg/kg in at a maximum value of 95 mg/kg; lead was above the PRG of 400 mg/kg with a maximum value of 1,300 mg/kg; and the iron concentration of 150,000 mg/kg exceeded the PRG of 54,750 mg/kg. Arsenic values ranged from 0.92 mg/kg to 40.7 mg/kg (sample 1BH036-BS-005-0, compared to a PRG of 0.39 mg/kg. Metals were co-located with uranium in six out of 10 borings, primarily in the same depth interval.

VOCS and SVOCs

VOCs were detected above PRGs in four samples. The greatest frequency and highest concentrations of VOC compound exceedances were reported for Sample 1BH018-BS-080-0 (benzene, methyl chloride and total xylene). The maximum value at this location was for total xylenes (240,000 micrograms per kilogram (µg/kg) compared to a PRG of 214,000 µg/kg). SVOCs were detected above the PRG in 13 soil samples, with the greatest frequency and highest concentrations in sample 1BH013-BS-050-0 (1,2,4-trichlorobenzene, 1,4-dichlorobenzene, carbazole, naphthalene) SVOC concentrations in this sample ranged from 720,000 µg/kg 1,4-dichlorobenzene (PRG of 3,200 µg/kg) to 1,600,000 µg/kg naphthalene (PRG of 125,000 µg/kg). VOC and SVOC compounds were primarily detected in deeper soils (i.e., five to 10 ft in depth). It should be noted that several SVOC compounds, such as chrysene or benzo(a)anthracene, are also reported as PAHs (PAHs are a subset of SVOCs and analyzed by different methodologies).

Thus, these compounds are presented in the PAH discussion below. VOC and SVOCs were detected in six of the same locations as uranium, although at differing depth intervals.

PAHs, PCBs and Pesticides

PAH compounds were detected above the PRG in seven of the 10 soil samples analyzed. PAHs were detected consistently in samples from locations 1-SB-01 and 1-SB-04. The highest reported concentrations were in soil sample 1-SB-01-BS-P-02. PAH concentrations in this sample ranged from 560 µg/kg dibenzo(a,h)anthracene to 3,600 µg/kg benzo(a)anthracene. The PRGs values for these compounds are 14.8 µg/kg and 148 µg/kg, respectively.

PCBs were detected above the PRG values in three of the 17 samples analyzed. The maximum concentration (Aroclor-1254 at 12,000 µg/kg) was in sample 1BH036-BS-005-0. The PRG for Aroclor-1254 is 222 µg/kg. Pesticides were detected in one soil sample (1BH036-BS-005-0) out of the seven samples analyzed. The PRG for aldrin (28.6 µg/kg) was exceeded in this sample, with a reported concentration of 46 µg/kg. In general, PAH, PCB and pesticide compounds were found in shallow soils (i.e., less than one foot in depth). These compounds were detected at five locations where uranium was also detected, usually within the same depth interval.

4.2.1.3 Concrete Samples

The calculated total uranium results for concrete cores based on the on-site and off-site gamma spectroscopy analysis are summarized in Table 4-2. Analytical results are provided in Appendix F. Exceedances of the ISV are highlighted in both Table 4-2 and Figure 4-9. Locations where concrete samples were collected are depicted on Figures 4-3 and 4-4.

The sample depths for concrete presented in the table are based on a starting depth below the existing gravel cover; therefore, concrete core samples correlate to the top of the concrete slab below the 12 to 18 inch gravel cover present over most of the Former Building 845 footprint. This cover was removed at each location prior to sampling; therefore, the top of the concrete core surface was referenced as zero ft. The concrete cores were generally six to eight inches in thickness.

A total of seven concrete samples were collected at six locations within the former building footprint and within the Uranium Oxide Area. The distribution of sampling locations across the

former building area provided sufficient coverage to assess the extent of both horizontal and vertical contamination. The ISV of 14 pCi/g for total uranium was exceeded for one of the concrete core samples. Sample 1BH022-CC-000-0, located in the southern portion of the building, contained 28 pCi/g total uranium. The soil sample collected from below the concrete in 1BH022 had a total uranium activity less than the ISV. These results indicate that the concrete is not a source of potential uranium contamination in subsurface soils.

As previously presented, location 1BH009 had a total uranium activity of 579 pCi/g in the soil sample, and the total uranium activity in the first soil sample under the slab at location 1BH010 was 18 pCi/g. Because the concrete is not contaminated in either location, it is likely that the near surface soils were potentially contaminated by lateral movement of uranium containing materials under the building slab (cracks in the slab, leaks from process lines or drains, or spills from the Uranium Oxide Area).

The Sitewide RI results are generally consistent with those from the 1983 BNI study. A greater number of concrete cores and subsurface soil samples were collected during the 1983 BNI study within the building footprint as compared to this RI. The previous study indicated a wider distribution of elevated uranium activity (U-238) in concrete cores and subsurface soils under the concrete slab throughout the former building footprint. Elevated uranium concentrations were reported in the north and midsection of the original building footprint. No samples were collected during the BNI study from the area of the western addition to the building. The vertical extent of uranium contamination reported in the BNI study report (BNI, 1985) for the Former Building 845 Area is also consistent with the RI results. The vertical extent of uranium contamination was reported to a depth of 3.75 ft.

4.2.1.4 Test Pits

Elevator Shaft

The elevator shaft was originally to be investigated as part of the concrete coring portion of the RI; however, a large amount of subsurface debris, including metal, bricks, concrete rubble, and wood, was encountered, which prevented advancement of hollow-stem augers. It was decided to remove this material from the shaft using excavation equipment to facilitate characterization of the debris materials and provide access to the shaft foundation. Once all the contents of the

elevator shaft were removed by the excavator and placed on the liner at the surface, direct readings were obtained.

Table 4-7 presents the results of the direct and removable (i.e., wipe) measurements performed on debris from the elevator shaft. Measurements were collected on debris within the elevator shaft to determine if any radiological contamination existed. The radiological technician noted that much of the debris material was "oily and wet" during performance of the survey. Because alpha particles are significantly attenuated and/or stopped by absorbers such as water, oil, and dirt, the beta measurements are considered more reliable indicators of the surface uranium activity. Total beta surface activity measured on the debris ranged from 3,700 to 280,000 dpm β/100 cm^2 and 70% exceeded the average acceptable contamination guideline from EM 385-80-1.

Only two of the 10 wipe samples were greater than the detection sensitivity of the wipe analysis. One of these wipe samples was 1,600 dpm β/100cm^2, exceeding the removable criterion. Total and removable alpha analyses were considerably lower than beta results, indicating that alpha particles were significantly attenuated and a poor indicator of uranium activity.

Once the debris was temporarily removed from the shaft, a concrete punch attachment on the excavator was used to break up the base of the elevator shaft. Pieces of the broken concrete and underlying soil were brought to the surface with the excavator bucket. The excavator bucket was decontaminated between each phase of the operation to prevent cross-contamination. Three concrete samples were collected (1TP025-CC-050-0-1, -2, and -3), and three soil samples (one primary and two field replicates) were collected from the underlying soil (1TP025-BS-065-0-1, -2, and -3). The results of the radiological analysis of the concrete and primary subsurface soils samples are presented in Table 4-2. Figure 4-9 also presents the radiological analytical results for these samples. The range of total uranium concentrations in the concrete samples is one to eight pCi/g. These results are less than the ISV for total uranium. The result for the primary soil sample collected below the concrete slab was below the ISV. One field replicate (data in Appendix F) was reported as 58 pCi/g. In addition, the sample designated as Elevator Shaft (zero to two ft bgs) contained total uranium at 177 pCi/g. Thus, soil in excess of the ISV was identified beneath the elevator shaft. This is also indicated in Figure 4-9.

A substantial amount of water remained within the shaft after the debris was removed. The water was removed from the shaft to the extent possible with a trash pump and placed into 55 gallon drums. Some water remained in the open shaft prior to breaking up the concrete slab. A grab sample of this removed water was collected and sent to the analytical laboratory for IDW characterization. IDW characterization results are provided in Appendix D.

Uranium Oxide Area

The test pit program for the Uranium Oxide Area consisted of completing a series of test pit using a Case CX160 excavator and 36 inch bucket, as described in Section 2.2.5. The first area to be investigated was adjacent to 1BH036. The yellow material and underlying soils were exposed in this area and were surveyed with the appropriate radiological instrumentation. Transects were established from this source material radiating from the former building foundation toward the east (in the area not covered by the building concrete pad). From the initial test pit location at 1BH036, test pits were completed along transects approximately 10 to 15 ft from this initial location, and then approximately five to 10 ft from the first locations. The program, therefore, consisted of a series of test pits along transects from 1BH036 as shown in Figure 4-4**.** A total of 24 test pits were completed.

A Micro-R meter was used to estimate gamma exposure rates at each test pit location. An action level of greater than 20 µR/hr was established to bias soil sample collection to areas in excess of background. At locations 1TP010, 1TP019, and 1TP020, the Micro-R meter reading exceeded 20 µR/hr, but concrete was encountered at these locations so no biased soil samples were collected. A total of 12 soil samples were collected as shown in Table 4-8. Three of these samples were submitted to the off-site laboratory for gamma spectroscopy and two were submitted for alpha spectroscopy analyses.

Total uranium activity measured in the samples ranged from 4.9 to 27,600 pCi/g. The highest total uranium concentration was reported for 1TP018, located within several feet of 1BH036, where the uranium oxide material was encountered and the highest uranium concentrations in surface soils were encountered. In the next set of test pits located approximately 10 ft south, east, and northeast (1TP013, and 1TP014), the total uranium concentration was below the ISV. Test pits and boreholes farther to the east and northeast of these sets of sampling locations,

however, indicate total uranium concentrations well above the ISV, ranging from 121 to 432.1 pCi/g at locations 1TP22, and 1TP023. Total uranium concentrations above the ISV are also reported in surface soils farther to the south (1TP007, 132.6 pCi/g) of the first set of test pits in the area of a concrete slab that could have been a loading or storage area.

In several of the test pits where the Micro-R meter reading was above the action level, a black material was observed at the near surface (within the first foot of soil below the gravel cover). Samples collected from test pits were generally collected from the exposed soil at the bottom of the test pit (typically 1.5 to two ft). To further investigate the black material and migration of activity to subsurface soils, a sample of this material (0.5 to one foot) and the underlying soils (two to 2.5 ft) were collected in 1TP024. The results indicate that this black material possesses a total uranium concentration of 363 pCi/g. The underlying soil has a uranium concentration below the ISV. The black material at the surface is likely a different form of uranium oxide that is encountered in localized areas of this Uranium Oxide Area. The uranium contained in this material is of low mobility.

The results of the Uranium Oxide Area investigation indicate that the yellow uranium oxide material encountered at 1BH036 appears to be localized and not observed in boreholes and test pits within several feet of this location. Elevated activity was observed within a radius of several feet from 1BH036, but decreased to below the ISV within five to 10 ft. However, surface soils containing total uranium concentrations well above the ISV, but significantly below the levels at 1BH036, were observed in outer test pits and boreholes, indicating impacts to soils throughout the area between the former building and east to the wooden trough. Another possible form of uranium oxide (black material) was also observed in several test pits within the near surface (zero to one foot). This form of uranium oxide appears to have low mobility in soils. The overall test pit and borehole results in this area indicate that the uranium has not migrated appreciably to subsurface soils, and is limited to the upper two to four ft. SEM/XRD analysis was performed on one of the samples and showed that the major uranium mineral was uraninite, a low-solubility mineral with a [+4] ion.

4.2.2 AOC 2, F Parking Corral

4.2.2.1 Source Zones

As described in Subsection 1.2.2.2, the DuPont MED contracts that were associated with the F Parking Corral included Project 9634 – Contract W-7412-Eng 3. The documented processes and the structures associated with this contract are shown in Figure 1-3 and Figure 1-6, respectively.

Under Contract W-7412-Eng 3, DuPont was to convert sodium uranite ($Na_2U_2O_7$), commercial black oxide (U_3O_8), and uranium peroxide dihydrate (UO_42H_2O) to brown oxide (UO_2). The brown oxide was then converted to green salt (UF_4), which in turn was converted to uranium metal. Based on the historical documentation provided by USDOE , Buildings 708 and 205 were utilized for execution of this contract. Building 708 was used for production and later demolished. Potential radiological source materials could therefore be associated with possible residual material from operations within and materials handling adjacent to Building 708 (USDOE 1996).

The location of Former Building 708 is the smaller building located in the northeastern portion of the F Parking Corral based on review of the DOE document (DOE, 1996) and the maps provided by Bechtel for the historical sampling event (BNI, 1985). The location of Building 708 shown in these two documents is consistent; however, the historical account of the demolition of Building 708, which was to have occurred in 1953, is not consistent with the historical aerial photographs for 1954.

The results of previous historical sampling indicate higher radiological activity in soil and groundwater samples within and adjacent to the footprint of the Former Building 708. The historical results provide further collaboration on the location of the Former Building 708. A cluster of higher uranium activity (>300 pCi/g) in soils was reported in this localized area within the former building footprint. Groundwater samples (unfiltered grab samples collected from open boreholes) indicated elevated uranium activity in groundwater within the former building footprint and to the north to northeast of the former building. These data indicate that uranium activity in soils and potentially in groundwater decreases as the distance away from the former building increases. The historical sampling program was limited and did not investigate possible

residual uranium contamination in the drainage ditch or other portions of AOC 2. It is possible that the CDD and the open ditch to the north received process waters from Building 708.

Potential source areas that were identified during the historical data review process and development of potential biased points include the footprint of the Former Building 708 and the immediate adjacent areas. Potential areas where residual contamination was suspected included the open drainage ditch to the north and its discharge into the CDD.

4.2.2.2 Soils and Vadose Zone, AOC 2

A total of 63 borings were completed in AOC 2. Two hundred and twenty seven soil and three concrete samples, plus duplicates and third-party splits were collected from these borings. All 210 soil samples were analyzed in the onsite laboratory for total uranium via gamma spectroscopy. One hundred and twenty six samples were shipped to the offsite laboratory for total uranium via gamma spectroscopy, while 10 samples were analyzed offsite via alpha spectroscopy. Analysis of Th-234 and U-235 (both gamma spectroscopy) was performed on 136 soil samples; while 15 samples were analyzed for U-235 (alpha spectroscopy), U-234 and U-238 (alpha spectroscopy). Twenty samples were analyzed for Th-230 and 24 for Ra-226 (both alpha spectroscopy). Chemical constituents (TAL metals, VOCs and SVOCs) were also analyzed in a subset of 16 soil samples from AOC 2 in support of the BRA.

The complete database of analytical results for soils and concrete, including QA samples, is provided in Appendix F.

4.2.2.2.1 Radiological Constituents

Uranium

As previously discussed, characterization results for total uranium were compared to the ISV of 14 pCi/g in order to define the extent of potentially contaminated soil. Analytical results for total uranium from both the onsite and offsite laboratories are presented in Table 4-9. The maximum concentration reported for any sample location (onsite or offsite analysis, gamma or alpha spectroscopy) is presented in the text and depicted on Figure 4-12. A brief summary of the isotopic uranium results is provided here; analytical data results are presented in tabular format along with the other eligible radiological contaminants Ra-226 and Th-230.

Sixty-four of the Th-234 samples were non-detect (47%), while reported concentrations ranged from 0.62 pCi/g to 7,969 pCi/g. Uranium-234 and U-238 were reported in all samples, with ranges of 1.56 pCi/g to 9,459 pCi/g, and 1.46 pCi/g to 9,543 pCi/g. respectively. The 15 U-235 alpha spectroscopy samples ranged between 0.04 pCi/g and 503 pCi/g. Of the 136 U-235 gamma samples, only 28 (20%) were reported as detects, with concentrations between 0.19 pCi/g and 646 pCi/g. The highest concentrations of these isotopes were detected in at least seven of the same sample locations for which uranium concentrations above the ISV were detected as discussed below. The maximum concentration of these isotopes was reported in 2BH018.

Of the 228 soil samples collected from AOC 2 soil borings, analytical results for total uranium in 129 samples (or 57%) were reported as "ND", with reporting limits ranging from 0.1 to 11.5 pCi/g. A total of 53 samples contained total uranium concentrations that exceeded the ISV of 14 pCi/g. As discussed previously, the data is presented against the ISV since it was the screening threshold used during the course of field work.

Table 4-9 presents the analytical data for total uranium in soils within AOC 2. The results of the GWS for AOC 2 were previously displayed in Figure 4-8. Distribution of the total uranium in soils in AOC 2 is presented in Figure 4-12. As discussed under AOC 1 results, Figure 4-10 shows the depth of uranium contamination above the 14 pCi/g ISV. The horizontal and vertical extent of soils potentially contaminated above the ISV is discussed below.

Horizontal Extent of Uranium Contamination

In AOC 2, the GWS was extended slightly beyond the AOC boundaries due to elevated readings detected along the roadway leading to the rail yard along the southern boundary of the AOC. A total of 5.4 acres was surveyed within this AOC. As depicted on Figure 4-8, the majority of AOC 2 is within a Z-Score of two, indicating little variability of radiological constituents across the surface of the AOC. This figure shows the nine areas within AOC 2 exhibiting Z-Scores above three. Five locations were in the northeast portion of the site bordering AOC 1, while the four remaining areas were located in the southeast corner of AOC 2 adjacent to the CDD. Biased sample points were installed in these nine locations to further investigate the source of the elevated gamma measurements. These locations included 2BH020, 2BH038, and 2BH039 through 2BH043.

Vertical Extent of Uranium Contamination

The 19 borehole locations where the ISV for total uranium was exceeded were located in the east portion of the F Parking Corral. These locations are associated with two specific areas of AOC 2:

- Demolished Building 708: 2BH010, 2BH018, 2BH025, 2BH026, 2BH027, 2BH038, 2-MW-01, 2-MW-02, 2-MW-03, 2-MW-05, 2-MW-25, 2-SB-06, 2-SB-07, 2-SB-09 and 2-SB-10
- CDD: 2BH020, 2BH042, 2BH043 and 2-MW-020.

Each of these borehole locations is proximate to the potential source area (Former Building 708) or a potential residual contamination area (northern ditch and CDD) of the F Parking Corral Area.

Three of the four AOC 2 CDD borings that exceed the ISV are located in the northeast portion of the AOC. Depth of potentially contaminated soil in this area was up to 1.5 ft bgs, consistent with the depth of potential contamination detected along the CDD in AOC 1. Concentrations of total uranium in soil exceeding the ISV ranged from 132 pCi/g (one foot bgs; 2BH020-SS-000-0) to 385 pCi/g (1.5 ft bgs; 2BH042-SS-000-0). The remaining CDD borehole (2-MW-020) was located along the CDD to the southeast of Building 708 and contained a total uranium concentration of 238 pCi/g in the first six inches of soil.

Of the 15 borings associated with the demolished Building 708, seven are located outside the building footprint and exhibit soils potentially contaminated above the ISV at depths of less than 3.5 ft bgs. Total uranium concentrations ranged from 34 pCi/g (3.5 ft bgs; 2BH-25-BS-020-0) to 800 pCi/g (1.5 ft bgs; 2-SB-07-BS-P-01). Within the building footprint, potentially contaminated soils were detected at depths of up to eight ft bgs, with the highest concentrations detected in the three to four ft bgs interval. At this interval concentrations ranged from 4,832 pCi/g (2BH018-BS-025-0) to 16,584 pCi/g (2BH038-BS-020-0). Uranium concentrations in the 4.5 to seven ft bgs interval ranged from 23 pCi/g (2BH026-BS-040-0) to 2,180 pCi/g (2-MW-02-B-P-02). In addition, 2BH018 was potentially contaminated at a depth of eight ft (19 pCi/g).

Two of the borings within the building footprint were potentially contaminated at discrete intervals only (2-MW-05 and 2-MW-25). The other borings exhibited potentially contaminated

soils across depth intervals. Most notably, 2-MW-02 and 2BH018 were potentially contaminated from the surface to depths of seven and eight ft, respectively. Borings 2-SB-10 and 2BH038 were potentially contaminated from the surface to a depth of 3.5 ft. Boring 2-MW-03 was potentially contaminated at the two to three ft depth as well as the eight to 11 ft depth interval.

The horizontal and vertical boundaries of potential uranium contamination presented in Figures 4-10 and 4-12 for the F Parking Corral Area encompass the potential source area of the Former Building 708 and potential residual contamination areas within and adjacent to the northern drainage ditch and the northern portion of the CDD that traverses AOCs 1 and 2.

The perimeter systematic grid samples collected during the RI defined the extent of contamination in the F Parking Corral Area. The ISV was not exceeded in the outer perimeter grid locations. As discussed above, surface soil samples associated with the northern portion of the CDD in AOC 2 exceeded the ISV. Two biased samples were collected in AOC 1 (1BH028 and 1BH026) on the side slopes of the CDD just north and downstream of 2BH020 and 2BH042), as shown on Figure 4-12. Total uranium concentrations in 1BH028 were below the ISV, suggesting that contamination in the northern drainage ditch is limited to the southern side (also supported by the results of 2BH011). The concentration of total uranium in the downstream location at 1BH026 exceeds the ISV. Further investigation of downstream migration of sediments containing residual uranium contamination is discussed in Section 5.0

The exceedance of the ISV in 2BH042 and 2-MW-020, located adjacent to the portion of the CDD that has been channeled into two underground concrete culverts, suggests residual contamination associated with the CDD to the east of Former Building 708. Additional horizontal delineation to the east is not required because samples were collected at these locations as part of the soils investigation for the Former Building 845 Area.

Uranium identified in the subsurface is associated with the boreholes installed within and around the footprint of the demolished Building 708. Although the historical records indicate this building was demolished and the debris and surface soils were disposed of in the Historical Lagoon A, the uranium contamination in this area is likely the result of the demolition and

backfilling activities associated with this building. The vertical extent of uranium contamination is deeper in the Former Building 708 Area than indicated for the Former Building 845 Area.

Uranium concentration in subsurface soil samples collected from boreholes along the northern drainage ditch where it discharges to the CDD did not exceed the ISV; however, borehole 2BH043 had a surface sample exceeding the ISV, but did not have any subsurface samples collected because of the presence of underground utilities at this area.

A limited number of samples were collected in the F Parking Corral Area during the 1983 BNI study. Historical sampling locations were focused within and adjacent to the footprint of the Former Building 708. The results of the current RI appear to be generally consistent with those from the previous study. The highest activity of uranium (U-238) in the 1983 sampling was associated with locations within and immediately west of the demolished Building 708.

The vertical extent of uranium contamination reported in the BNI study report (BNI, 1985) for Building 708 is also consistent with the RI results of the OU 1. Vertical extent of contamination was reported to extend to a depth of eight ft bgs. The highest activity was observed in the two to four ft range.

Other Radiological Constituents

The maximum concentrations of the other radiological constituents analyzed in AOC 2 soil borings were collocated with uranium in one of the sample locations for which uranium contamination was detected. Sample 2-BH018 (zero to two bgs) contained the highest concentrations of Th-230 (32.3 pCi/g, alpha spectroscopy). As presented above, total uranium in this sample was 1,360 pCi/g. The remaining soil sample concentrations for Th-230 ranged between 0.19 pCi/g and 15 pCi/g. Radium-226 data (alpha spectroscopy) was reported between 0.37 pCi/g and 2.87 pCi/g. Table 4-10 presents the analytical results for the radiological isotopic samples, while Figure 4-13 shows the distribution of results across AOC 2.

4.2.2.2.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for residential soil. As mentioned in AOC 1, these PRGs were chosen for use because they represent the most recently updated

human health screening values and in most instances are more conservative than the values published in the State of NJ standards. Full data presentations are presented in Appendix F. Table 4-11 presents a summary of those metals constituents that exceed the PRG values. Table 4-12 presents an exceedance summary for VOCs and SVOCs; and Table 4-13 presents a summary of exceedances for PAH, PCB and pesticide compounds. Analytical results for chemical constituents are compared to background constituent concentrations in the background screening step of the BRA (CABRERA 2011b). The reader is referred to Appendix B of the BRA, Tables B-1-2 through B-1-6 (Surface Soil) and Tables B-2-2 through B-2-7 (All Depth Soil).

Metals

Of the 16 soil samples, less than seven reported detected concentrations of beryllium, cadmium, selenium, silver and thallium. Arsenic and mercury were detected in 15 of the samples; while two others were reported in nine and 10 samples (antimony and sodium, respectively). The remaining 14 metals were detected in all samples. Five metals have concentrations that exceeded the respective PRG.

Arsenic was reported above the PRG of 0.39 mg/kg in 15 soil samples, with concentrations ranging from 1.1 mg/kg (2-SB-10-SS-P-00) to 20 mg/kg (2-SB-06-SS-P-0). Chromium was detected in four soil samples, ranging from 30.8 mg/kg (2BH004-BS-015-0) to 67.1 mg/kg (2BH044-BS-001-0), compared to a PRG of 30.1 mg/kg. Copper, iron and lead each had one detection above their respective PRG values. Metals were co-located with uranium in five of 10 borings, primarily at the same depths

VOCS and SVOCs

VOCs were detected in 15 of the 16 soil samples at depths up to 2.5 ft. Of these detections, only one was above the respective PRG value. Benzene reported at 930 µg/kg in 2BH004-BS-0150-0, compared to a PRG of 656 µg/kg. VOCs for which the analytical detection limit exceeded the respective PRG value, and for which the compounds were reported as 'non-detects', are shown for one additional soil sample.

SVOCs were detected in 13 of the 16 soil samples at depths up to 2.5 ft. Of these, nine samples contained SVOCs in exceedance of their respective PRG values. The maximum reported SVOC

concentration was 390,000 µg/kg 1,4-dichlorobenzene in sample 2BH004-BS-015-0. The PRG for this SVOC is 3,200 µg/kg. SVOCs were detected with the greatest frequency of exceedances in 2-SB-07-SS-P-00 and 2-SB-08-BS-P-00. SVOCs for which the analytical detection limit exceeded the respective PRG value, and for which the compounds were reported as 'non-detects', are shown for an additional three soil samples. It should be noted that several SVOC compounds, such as chrysene or benzo(a)anthracene, are also reported as PAHs (PAHs are a subset of SVOCs and analyzed by different methodologies). Thus, these compound are presented in the PAH discussion below. VOCs and SVOCs were detected in six of seven borings with uranium concentrations above the ISV, primarily in the same depth intervals.

PAHs, PCBs and Pesticides

PAH compounds were detected in 10 out of 10 soil samples analyzed, with depths ranging from one to three ft. PAHs were detected above the PRGs with greatest frequency (five exceedances) and with the highest reported concentrations in soil boring locations 2-SB-06, 2-SB-07, 2-SB-08 and 2-SB-09. The maximum PRG exceedances reported for these four locations were:

- 2-SB-06-BS-P-02: 4,300 µg/kg benzo(a)pyrene and benzo(b)fluoranthene (PRGs of 14.8 µg/kg and 148 µg/kg, respectively)
- 2-SB-07-SS-P-00: 2,400 µg/kg benzo(b)fluoranthene
- 2-SB-08-BS-P-01: 1,000 µg/kg benzo(b)fluoranthene
- 2-SB-08-SS-P-00 : 820 µg/kg benzo(b)fluoranthene
- 2-SB-09-BS-P-01: 420 µg/kg benzo(b)fluoranthene

PCB compounds were detected in 10 of the 16 soil samples at a depth of 2.5 ft or less. Aroclor-1260 was detected in nine of the samples, with a maximum PRG exceedance of concentration of 5,900µg/kg. Aroclor-1221 was detected at 18,000 µg/kg in 2BH004-BS-0150-0. The PRG value for both of these PCB compounds is 222 µg/kg.

Pesticides were reported in one soil sample (2BH004-BS-015-0) at a depth of 2.5 ft and a maximum concentration of 260 µg/kg alpha-BHC. The PRG value for this pesticide is 90.2 µg/kg. PAHs, PCBs and pesticides were detected in six of seven borings with uranium concentrations above the ISV, primarily in the same depth intervals.

4.2.2.3 Concrete Samples

The four concrete samples from the F Parking Corral Area were collected from three boreholes (2BH015/2BH015R, 2BH024/2BH024R, and 2BH032). Each of these locations is within the

footprint of the large demolished building located to the south of Building 708. The concrete was encountered in the locations at the six to eight ft depth interval. The total uranium activity in the concrete samples did not exceed the ISV of 14 pCi/g. The RI data for the F Parking Corral Area indicate that at the isolated locations where contamination was found at depth, total uranium exceeded the ISV to an approximate depth of eight ft, which corresponds to the depth of the demolition debris and fill soils that are likely associated with the demolition of the Former Building 708. Additionally, because the groundwater table was typically encountered at six to eight ft bgs, total uranium activity exceeding the ISV was not generally found within the saturated zone soils, except locations 2BH018 and 2BH038 located within the Former Building 708.

4.2.2.4 Test Pits

The F Parking Corral Area test pit investigation included two test pits in the former building footprint of Building 708. Two test pits (2TP001 and 2TP002) were completed in the area of the Former Building 708 in the F Parking Corral (Figure 4-6). The purpose of these test pits was to facilitate characterization of buried debris in these areas. At each location, debris was removed from the pit and placed on a liner, where a radiological technician performed direct radiation measurements to estimate total surface contamination levels. The materials encountered included wood, general debris, and concrete slab.

Three direct radiation measurements were performed at 2TP001 (see Table 4-14). One measurement was less than the detection sensitivity. The other measurements were 5,600 and 7,800 dpm β/100 cm^2, slightly exceeding the EM 385-1-80 acceptable average surface contamination guidelines. One measurement was performed in 2TP002. Its result (5,600 dpm β/100 cm^2) also slightly exceeds the guideline. Based on these data, debris in these test pits are lightly contaminated, much less so than debris in the elevator shaft, but exceed EM 385-1-80 surface contamination guidelines.

4.2.3 Groundwater

4.2.3.1 Initial (Piezometer) Characterization Results

Groundwater Geochemistry

The redox chemistry observed throughout AOC 1 during the piezometer sampling indicated oxidizing to slightly reducing conditions. The redox chemistry observed throughout AOC 2 was

more variable than in AOC 1, and indicated that this area is only slightly reducing. A more comprehensive geochemical dataset was obtained during the subsequent quarterly monitoring well sampling program and thus was utilized for characterization purposes. In general, the subsequent data results from the monitoring well program indicate reducing conditions in both AOCs.

The results of the geochemical analysis of filtered groundwater samples indicate that bicarbonate is the primary carbonate ion present in the shallow groundwater. Discussion of the role of carbonate species in the mobility of uranium species present in groundwater is presented in Section 7. Piezometer sampling records are provided in Appendix G-1.

Uranium- AOC 1

One round of groundwater samples from the B aquifer were collected at 21 of the 33 grid and biased Geoprobe sampling locations in the Former Building 845 Area. Filtered and unfiltered samples were collected from the temporary piezometers at each of these boreholes and analyzed for radiological parameters. The results for both filtered and unfiltered isotopic and total uranium samples from the B aquifer are presented in Table 4-15. Total uranium results exceeded the USEPA Maximum Contaminant Level (MCL) of 30 µg/L have been highlighted. The location of these piezometers and both the filtered and unfiltered sample results are presented in Figure 4-14 for AOC 1. The presence of total uranium concentrations above the MCL is the focus of the discussion presented below.

The USEPA MCLs are drinking water standards and thus are intended to be applied to representative filtered samples. Samples from temporary piezometers may contain suspended particulates and are not always considered to be "representative". While filtering the piezometer sample may assist in yielding a fairly representative groundwater geochemical sample, these samples are compared to Federal standards for screening purposes only. It is also important to note that the uranium results reported by the laboratory as pCi/L have been converted to mass units of µg/L by dividing the result by a factor of 0.667 to allow comparison to the MCL. This conversion is consistent with the USEPA published range of uranium conversion values for going between gross alpha (assuming all uranium) and mass spec results in the 2000 MCL Rule. Actual picoCuries per micrograms (pCi/µg) conversions for individual isotopes could be

calculated, but for simplicity, a single point conversion that is consistent with the USEPA guidance was applied.

The results for the filtered groundwater samples for AOC 1 indicate no exceedances of USEPA drinking water standards for total uranium. The maximum total uranium concentration in the filtered groundwater samples was 12 µg/L, which is less than half of the MCL standard of 30 µg/L. In contrast, the MCL was exceeded in two unfiltered samples; 1-BH002-GW-001-0 (69.5 µg/L) and 1BH17-GW-001-0 (31 µg/L).

As shown on Figure 4-14, one location, 1BH017, is located near the south section of the wooden trough and southeast of the Uranium Oxide Area and location 1BH002 is adjacent to the CDD in the northern portion of AOC 1.

It should be noted that the concentrations of radiological parameters in the unfiltered groundwater samples are generally greater than the filtered samples. These results would be expected because the unfiltered samples may contain suspended solids with potentially sorbed radioactive materials as a result of downward movement of contaminated surface soils during the installation of the temporary piezometers. Comparing unfiltered and filtered total uranium concentrations indicates that approximately 60% to 65% of the total uranium concentrations in the unfiltered groundwater samples are sorbed to the suspended solids.

Other Radionuclides – AOC 1

In addition to uranium, groundwater samples were analyzed for gross alpha, gross beta, total radium and Th-234. Results are listed in Table 4-16. For those radionuclides with corresponding MCL values, the results exceeding the MCL have been highlighted. Filtered and unfiltered results (in parentheses) are shown on Figure 4-15. The results for the filtered groundwater samples for AOC 1 indicate no exceedances of USEPA drinking water standards for gross alpha (maximum concentration of 12.83 pCi/L) or total radium (maximum concentration of 1.55 pCi/L). Four wells exhibited gross alpha exceedances and two contain total radium exceedances for the unfiltered samples. The highest reported concentration of gross alpha was 141 pCi/L in Sample 1BH002-GW-001-0, along with 9.15 pCi/L total radium and the

maximum gross beta concentration of 205 pCi/L. These concentrations are attributable to the presence of uranium in the groundwater.

Uranium- AOC 2

One round of groundwater samples was collected at 34 of the 43 grid and biased Geoprobe sampling locations in the F Parking Corral Area. Both filtered and unfiltered samples were collected from the temporary piezometers at each of these boreholes and analyzed for radiological parameters. The results for both filtered and unfiltered isotopic and total uranium samples are presented in Table 4-17. Total uranium results that exceeded the USEPA MCL of 30 µg/L have been highlighted. The location of these piezometers and the filtered and unfiltered sample results are presented in Figure 4-16 for AOC 2.

The USEPA drinking water standard for uranium (30 µg/L) was exceeded in one location within AOC 2 for filtered groundwater and in three locations for unfiltered samples. Sample 2BH018-GW-001-0 significantly exceeded the drinking water standard for total uranium with concentrations of 1,358 µg/L (filtered) and 3,505 µg/L (unfiltered). Location 2BH018 is located within the Former Building 708 and corresponds to the locations of the highest soil concentrations reported for AOC 2 (2BH018 and 2BH038 adjacent to 2BH018). To a lesser extent, the MCL was also exceeded in samples 2BH010-GW-001-0 (40.9 µg/L) and 2BH042-GW-001-0 (59.8 µg/L). The piezometer data suggests that contamination is localized and that significant quantities of uranium in the groundwater have not been mobilized during the timeframe since MED activities were conducted at AOC 2. Subsequent results from monitor wells installed in the area confirm this finding.

As discussed under the soil results, uranium contamination in the soil extends deeper than observed for AOC 1, and corresponds to the approximate depth of the debris layer. This debris layer extends to approximately eight ft within the Former Building 708 footprint and into the shallow groundwater table. The clay layer also appears to be absent in this area. The exceedance of the total uranium drinking water standard in 2BH018-GW-001-0 (Figure 4-5) is likely due to the direct contact of the contaminated debris layer with the shallow groundwater at this location, and the potential migration of uranium from surface material potentially

contaminated above the ISV due to preferential pathways created within the debris and the lack of adsorption sites resulting from the absence of the clay layer.

Other Radionuclides – AOC 2

Additional radionuclides were analyzed in the AOC 2 groundwater samples, as discussed above for AOC 1. Results are listed in Table 4-18 with the filtered and unfiltered results shown on Figure 4-17. Sample 2BH018-GW-001-0 also contained the maximum reported concentrations of gross alpha (864 pCi/L filtered and 2,004 pCi/L unfiltered) compared to the drinking water standard of 15 pCi/L. The gross alpha MCL was also exceeded in two additional filtered and 20 additional unfiltered samples, as shown on Table 4-18. Gross beta concentrations were also highest for both filtered and unfiltered results in sample 2BH018-GW-001-0 (770 pCi/L and 2,087 pCi/L respectively). Gross alpha and gross beta concentrations are attributable to uranium present in the groundwater. This sample (2BH018-GW-001-0) also contained the maximum reported concentrations of Th-234 (443.6 pCi/L filtered and 1,006 pCi/L unfiltered). Total radium slightly exceeded the drinking water standard of five pCi/L in two filtered samples and 10 unfiltered sample. The maximum exceedances were 13.32 pCi/L (filtered) and 24.4 pCi/L (unfiltered) in sample 2BH0130GW-001-0).

A non-aqueous phase liquid (NAPL) was also observed throughout the water column in 2BH013-GW-001-0. The NAPL composed predominantly of chlorobenzenes, may have been in contact with potentially contaminated radiological debris in the east portion of the site (Former Building 708 Area), and then may have migrated through preferential pathways in the demolition fill through the F Parking Corral to borehole 2BH013. The NAPL could potentially serve as an organic ligand that complexes radioactive materials, causing these radionuclides to migrate through the soil column through preferential pathways; however, the absence of uranium in the soils and groundwater at these western locations does not support this as a possible pathway for uranium migration from the potential source area within the Former Building 708 to these locations. The NAPL was further evaluated as part of the monitoring well investigation, discussed in Section 4.3.3.2.

4.2.3.2 Monitoring Well Sampling Results

Five to seven rounds of groundwater data have been collected quarterly from the monitoring wells installed in OU 1 and OU 2 since October 2004. The varying sample events are reflective of well installation dates and additional sampling requirements to meet DQOs. Comprehensive results are discussed below

Groundwater Flow

The piezometric surface in Aquifer A averages one foot higher elevation than Aquifer B in OU 1. Groundwater elevation in both Aquifer A and Aquifer B are above the level of the Central Drainage Ditch in OU 1. Groundwater flow direction in Aquifer A appears to be toward the CDD, while in Aquifer B, the flow direction is toward the northeast. Water level data obtained from the OU 1 and 2 wells for the past six quarters of sampling (quarters 1 through 6) are presented in Table 4-19. Figure 4-18 shows the groundwater elevation contours for the A aquifer during Quarter 5 (September 2006), while Figure 4-19 shows the contours for the B aquifer during this same quarter. After review of the quarterly sampling results Quarter 5 was selected as the representative sampling period. Quarter 6 was also evaluated but determined not to be representative because of the unusually low water, drought-like conditions that existed during that period. Quarter 7 sampling was not representative either since only a subset of the monitoring wells (those in OU 3) was sampled. The groundwater flow gradient in the A Aquifer appears to be largely dependent on the proximity to the CDD, but in the Dissolved Uranium Area the gradient is one foot / 100 ft (1%). The Dissolved Uranium Area is located beneath the Former Building 708. The groundwater flow gradient in the B Aquifer is much lower than in the A Aquifer. As shown in Figure 4-19, the gradient near the Dissolved Uranium Area is 0.2 ft / 100 ft (0.2%). Appendix I contains groundwater contour elevation maps for each sampling event. Groundwater level measurement forms are provided in Appendix G.

Long-term monitoring of water levels in the A Aquifer, B Aquifer, and CDD wells shows that B Aquifer wells are affected by tidal fluctuations while A Aquifer wells are not. Figure 4-20 shows heads and barometric pressures for the period from October 19, 2004 to November 9, 2004. The CDD appears to be maintained at a constant level by DuPont. All wells and the CDD

showed increased levels resulting from a storm event on November 4 when precipitation at the site was greater than one inch over a 24 hour period.

Slug Test Results

Slug tests were performed in 13 of the 18 wells. Wells 2-MW-01, 2-MW-03 and 2-MW-05 contained light nonaqueous phase liquid so it was considered inappropriate to increase the smear zone by performing slug tests in these wells. Hydraulic conductivities in Aquifer A ranged from 3E-5 to 2E-3 cm/s and averaged 9E-4 cm/s (or one foot per day). Hydraulic conductivities in Aquifer B ranged from 1E-4 to 8E-4 cm/s and averaged 5E-4 cm/s (or two ft per day). These values fall within the range expected for silty fine sands (*see* Freeze & Cherry, 1979; *and* Halford & Kuniansky, 2002). The results are summarized in Table 4-20. Slug test data are included in Appendix J.

Estimated Rates of Groundwater Flow

Using the measurements of K and flow gradient, the groundwater flux can be estimated using Darcy's Law (Freeze and Cherry, 1979). Seepage velocity (V_S) is usually derived using the following equation:

$$\mathbf{V_w=K*(dh/dx)/\theta}$$

Where:

V_w is the velocity of groundwater (also known as the seepage velocity (V_S)),
K is the hydraulic conductivity,
dh/dx is the average groundwater gradient and
θ is the porosity of the sediments

For the A Aquifer, the V_S was estimated using the average K of 9E-4 cm/s, average gradient of one ft / 100 ft (1%) and a literature-based average porosity of 30% for shallow fine-grained sediments (Freeze and Cherry, 1979). The average V_S is estimated to be approximately 0.7 meters per day (m/d) (2.3 feet per day [ft/day]).

For the B Aquifer, using the average K of 5E-4 cm/s, average gradient of 0.2 ft / 100 ft (0.2%) and average porosity of 30% yields an average V_S of 0.003 m/d (0.01 ft/day).

Groundwater Stabilization Parameters

Groundwater stabilization parameters (or *reactive* parameters) were measured during the purging of the wells prior to sampling. These parameters included pH, specific conductance, temperature, oxidation-reduction potential, turbidity, and dissolved oxygen. In addition, groundwater was analyzed at the time of purging for concentrations of ferrous iron, nitrite, and sulfide (which may be considered indicators of biodegradation activity), as well as for the presence of hydrogen peroxide. The methods used to measure each parameter are provided in Section 2.6.2.1. The water quality data representing stabilized conditions are presented in Table 4-21 while results for the additional sampling parameters are provided in Tables 4-22. Calibration logs for the YSI meters used in the field analysis are presented in Appendix K. Appendix L provides figures showing concentration trends in water quality data by quarter, as well as isopleth maps. The field results are described below.

The 13 A Aquifer wells were stabilized to a final turbidity of 10 NTUs or less (target level for sampling) in 50% to 80% of the sampling events. Most wells exhibited higher turbidity levels during quarters 2 and 6 sampling in general, and were considered stabilized when three consecutive NTU readings were within ±10%. The 12 B Aquifer wells were stabilized in a similar fashion. Two B Aquifer wells exhibited higher turbidity than others in at least one sampling round (well 2-MW-01B, 103 NTUs in quarter 5 and well 2-MW-05B, 518 NTUs in quarter 1). Well 2-MW-16B exhibited water color that could not be reduced when filtered through a 0.45 micron filter. The C aquifer well was stabilized to 10 NTUs or less for each sampling event other than quarter 6.

With a few exceptions, dissolved oxygen concentrations in each aquifer were less than 1.0 mg/L in all wells (76% of all samples), indicating a reducing environment. Average well values ranged from 0.18 mg/L to 3.5 mg/L in the A Aquifer, 0.13 to 2.4 in the B Aquifer and 2.1 mg/L in the C Aquifer. The average DO concentration over time was 1.15 mg/L for the A Aquifer; and 0.65 mg/L for the B Aquifer.

With the exception of well 3-MW-13B and a few samples from quarter 6, ORP values were strongly reducing in all aquifers, with average values ranging from -41 mV to -194 mV in the A aquifer, 56 mV to -269 mV in the B aquifer and -151 mV in the C aquifer. The average ORP

values (along with average DO values) for the OU 1 wells are shown in Figure 4-21. Average specific conductance values in the A aquifer ranged from 475 microSiemens per centimeter (µS/cm) to 1,900 µS/cm in the A aquifer. The B aquifer wells ranged from an average of 583 µS/cm to 1,953 µS/cm, while the average in the C aquifer well was 2,876 µS/cm.

The average value for pH was 7.7 in the A aquifer, 7.32 in the B aquifer and 8.8 in the C aquifer. Values for pH were circum-neutral in most wells except for three wells in the A aquifer and two in the B aquifer. Wells 2-MW-24A and 2-MW-26A contained consistent pH values of 10 or greater. Well 1-MW-08A had two rounds of pH greater than 10, the remaining sample pH values were around eight. Well 1-MW-11B and 1-MW-16B had pH values between 11.7 to 11.89 and 8.80 to 9.76, respectively. Areas with high pH also tended to have low redox potential.

Ferrous iron concentrations in the A aquifer peaked at approximately three mg/L near wells 2-MW-20A and 1-MW-21A, which are on the northern and southern boundaries of OU 1, respectively. The average concentrations for the A aquifer ranged from 0.03 to 3.17 mg/L. Ferrous iron concentrations in the B Aquifer showed a similar pattern of maximum concentrations of approximately three mg/L in the northern and southern areas and averaged 0.03 to 3.05 mg/L. Ferrous iron in the C aquifer well averaged 1.69 mg/L. Nitrite concentrations in all wells were less than one mg/L. Values for both ferrous iron and nitrite support a reducing environment. Average sulfide concentrations for all aquifers were less than one mg/L

Hydrogen peroxide average values were less than one mg/L for all aquifers. The maximum concentration in the A aquifer was reported as greater than 80 mg/L in 2-MW-26A (quarter 1); while the maximum value in the B aquifer was reported as greater than 45 mg/L in 1-MW-11B (quarter 3). During more recent sampling events, hydrogen peroxide was reported at less than two mg/L in 2-MW-26 and was not detected in 1-MW-11B.

Major Ions

Concentrations of major ions were analyzed to interpret their effect on uranium geochemistry. Concentrations of the inorganic ions chloride, fluoride, sulfate, phosphate (as phosphorous), nitrate/nitrite, and alkalinity were measured. Sample results are presented in Table 4-23.

In OU 1 average chloride concentrations in the A Aquifer ranged from 3.1 mg/L in sample 1-MW-08-GU-P-02 to 660 mg/L in samples 2-MW-12-GU-P-02 and 1-MW-22-GU-P-02. Average chloride concentrations in the B Aquifer were higher than in the A aquifer, ranging from 9.2 mg/L in sample 1-MW-09-GU-P-02 to 940 mg/L in sample 3-MW-GU-P-02. Groundwater from 2-MW-25 in the C aquifer contained an average chloride concentration of 1,340 mg/L. For comparative purposes, the NJDEP Water Quality Criteria (WQC) for chloride is 250 mg/L.

Total alkalinity as Calcium Carbonate in the A aquifer averaged 302 mg/L total alkalinity. This is classified as hard water, while total alkalinity in the B aquifer wells averaged 350 mg/L, which is "very hard" water. The C aquifer average alkalinity was 112 mg/L.

Sulfate concentrations averaged between 3.25 and 88.4 mg/L in the A aquifer wells. The maximum values (200 mg/L in 1-MW-08-GU-P-01 and 190 mg/L in 1-MW-10-GU-P-02 were detected in early sampling (i.e. Quarters 1 and 2); and subsequent sampling has indicated a decline in sulfate concentrations in these wells to 75 mg/L or less. In contrast, the average sulfate values in the B aquifer ranged from 1.04 to 1,080 mg/L. Sulfate concentrations in 2-MW-13B and 2-MW-14B were consistently elevated in comparison to other B aquifer wells. Concentrations in these two locations ranged 730 mg/L to 1,300 mg/L (2-MW-13B) and 280 mg/L to 490 mg/L (2-MW-14B). Sulfate concentrations in the remaining B aquifer wells ranged in general from 1.3 mg/L to 140 mg/L, consistent with values reported for the A aquifer. Sulfate values in the C aquifer well were also elevated with respect to the A aquifer (and the majority of the B aquifer). The average concentration for the C aquifer was 130 mg/L sulfate.

Fluoride and nitrite/nitrate values were low, and averaged 4.4 mg/L and 0.1 mg/L, respectively, in the A aquifer. Average concentrations were similar in the B aquifer (2.8 mg/L and 0.11 mg/L). Fluoride was not detected in the C aquifer well, and nitrite/nitrate in this well averaged 0.04 mg/L. Total phosphorus concentrations were low in the A and B aquifers, averaging 0.17 mg/L in the A aquifer and 0.57 mg/L in the B aquifer. Total phosphorus was not detected in the C aquifer.

Nitrate was sampled in six A aquifer and 11 B aquifer wells in October 2004, prior to the initiation of quarterly sampling. No detections were reported for any of the samples.

Major cation and anion results from the first sample event were plotted on a Piper diagram, shown in Figure 4-22. The average absolute value of the balance between cations and anions at each well location was 10%. The diagram shows that sodium and potassium dominate among cations and chloride and sulfate dominate among anions. Generally, a sodium-potassium-sulfate facies dominates.

Radiological Constituents

Comparison of Filtered and Unfiltered Groundwater Samples at Monitoring Well Locations

Groundwater radiochemistry samples were collected in filtered and unfiltered splits during five monitoring well sample events to test for the possible effect of colloids on unfiltered analysis results. Comparison of results from all wells for total uranium in filtered and unfiltered splits shows high correlation of the results; correlation coefficients ranged from 0.989 to 0.998. Table 4-24 shows the comparison of filtered and unfiltered analysis results for total uranium. As there was no statistical difference between filtered and unfiltered results, only unfiltered samples were collected from Quarter 4 onward, and only unfiltered groundwater results are presented in the following data presentations.

Uranium

All 25 monitoring wells were sampled for isotopic and total uranium in quarters 1 through 6. Two wells were sampled during quarter 7 and 14 previously existing wells were sampled in October 2004, prior to the commencement of the quarterly sampling. A total of 192 groundwater samples were analyzed for uranium. Comprehensive sample results for isotopic and total uranium are presented in Table 4-25. Uranium results have been measured using alpha spectrometry and are reported by the laboratory as a total uranium result (in pCi/L). These activity units have been converted to mass units of µg/L by dividing the result by a factor of 0.667. Total uranium results exceeding the MCL of 30 µg/L have been highlighted. These exceedances have been utilized to determine the extent of groundwater contamination, and are the focus of the discussion presented below.

Groundwater laboratory data for both primary and QA analysis are presented in Appendix H-2. The QA/QC evaluation results are presented in Appendix M.

In the AOC 1 area of the A aquifer, elevated total uranium is present in wells 1-MW-08A, 1-MW-10A, and 1-MW-18A. Sample 1-MW-08-GU-P-02 contained the maximum total uranium concentrations that exceeded the MCL of 30 µg/L. Elevated total uranium in this well ranged from 990 µg/L to 56,372 µg/L and averaged 26,317 µg/L. Total uranium ranged from 442 µg/L to 1,439 µg/L in sample 1-MW-18-GU-P-02, with an average of 1,091 µg/L and 38 µg/L to 205 µg/L (average 109 µg/L) in sample 1-MW-10-GU-P-02. These wells are located within or adjacent to identified potential sources of uranium contamination (i.e. footprint of Buildings 845) or isolated potentially contaminated soil areas. Soils with uranium concentrations above the ISV (14 pCi/g) were detected during drilling of 1-MW-08A (270 pCi/g). While no soil sampling was conducted during drilling of the other two monitoring wells, 1-MW-10A is located beneath Building 845 in an area of identified potentially contaminated soil and 1-MW-18A is adjacent to boring 1BH018 (149 pCi/g uranium in soil). The remaining wells were, in general, less than five µg/L for total uranium

In the AOC 2 area of the A Aquifer, the area of aqueous uranium impact is centered at wells 2-MW-02A, 2-MW-12A and 2-MW-15A. This general area is referred to as the Dissolved Uranium Area. Sample 2-MW-02-GU-P-02 also contained the maximum total uranium concentrations that exceeded the MCL of 30 µg/L. Elevated total uranium in this well ranged from 4,093 µg/L to 35,532 µg/L and averaged 14,027 µg/L. Total uranium ranged from 48 µg/L to 757 µg/L in sample 2-MW-15-GU-P-02 (average of 331 µg/L) and 44 µg/L to 472 µg/L in sample 2-MW-12-GU-P-02 (average of 168 µg/L). These wells are located within or adjacent to identified potential sources of uranium contamination (i.e. footprint of Building 708). Soils with uranium concentrations above the ISV (14 pCi/g) were detected during drilling of 2-MW-02 (2,180 pCi/g). While no soil sampling was conducted during drilling of the other two monitoring wells, 2-MW-12A is located adjacent to the Building 708 footprint and down gradient of identified locations of potentially contaminated soil. Location 2-MW-15A is also down gradient of identified locations of potentially contaminated soil. Consistent with AOC 1, the remaining wells in AOC 2 were, in general, less than five µg/L for total uranium.

Within the A aquifer, down-gradient control is provided by wells 1-MW-06A, 2-MW-19A, and 2-MW-20A. Up-gradient control is provided by well 1-MW-21A, 2-MW-22A, 2-MW-24A, and 2-MW-26A. The horizontal extent of uranium impact to groundwater remains defined by the extent of uranium impact in soil.

Average concentrations of isotopic and total uranium in the A aquifer are presented in Figure 4-23. Trends in total uranium concentration in the A aquifer over time are presented in Figure 4-24. Total uranium concentrations representing averages over time are shown in Figure 4-25. This figure demonstrates the limited aerial extent of uranium impacted groundwater in the A aquifer in relation to the extent of OU 1. The extent of impacted groundwater is approximately 0.5 acres compared to the 5.85 acres encompassing OU 1. Isopleth maps for individual sampling events are presented in Appendix N.

In the deeper B Aquifer, uranium impact to groundwater is limited to the area around wells 2-MW-03B and 2-MW-05B in AOC 2. Total uranium concentrations in sample 2-MW-03-GU-P-02 consistently exceeded the MCL of 30 µg/L, ranging from 7,406 µg/L to 74,813 µg/L, with an average value of 29,560 µg/L. Concentrations above the MCL in sample 2-MW-05-GU-P-02 ranged from 43 µg/L to 1,019 µg/L and averaged 167 µg/L. These two wells are located within the footprint of the Former Building 708, which has been identified as a potential source of uranium contamination to soils. In addition, soils with uranium concentrations above the ISV (14 pCi/g) were detected during drilling of these monitoring well locations (7,760 pCi/g in 2-MW-03B and 377 pCi/g in 2-MW-05B).

Within the B aquifer, down-gradient control is provided by well 2-MW-23B, while up-gradient control is provided by wells 2-MW-04B, 2-MW-05, and 2-MW-16B. It should be noted that while one sample from well 2-MW-04B was above the MCL (quarter 3, 35.8 µg/L) all other samples have been well below the MCL and the average total uranium concentration for this well is 10 µg/L.

Average concentrations of isotopic and total uranium in the B aquifer are presented in Figure 4-26. Trends in total uranium concentration in the B aquifer over time are presented in Figure 4-27. A total uranium isopleth map representing average concentrations in the B aquifer over time is shown in Figure 4-28. As shown on this figure, the extent of uranium impact to the

groundwater within the B aquifer is very limited in extent and covers a small area (0.2 acres) within the center footprint of the Former Building 708. Isopleth maps for individual sampling events are presented in Appendix N.

Results for total uranium in the C aquifer well 2-MW-25C demonstrate that contamination has not migrated vertically into the C aquifer. The maximum total uranium concentration was 1.42 µg/L. As shown on Figure 4-7, this well is located beneath the footprint of Building 708, downgradient of 2-MW-03B.

Other Radionuclides in Groundwater

In addition to radiochemical analysis for uranium described above, groundwater samples from all quarters (175 samples) were analyzed for the radiochemical parameters gross alpha/gross beta; Ra-226 and Ra-228. The thorium isotopes Th-228, Th-230 and Th-232 were analyzed beginning in quarter 4, resulting in 76 samples. Comprehensive radionuclide results are provided in Table 4-26. For those radionuclides with corresponding MCL values, the results exceeding the MCL have been highlighted.

Figures 4-29 and 4-30 show the average concentrations of these radionuclides in the A and B aquifer wells, respectively. Six of the 13 A aquifer wells exhibited gross alpha results above the USEPA MCL of 15 pCi/L. These wells are the same as discussed above for uranium. Average gross alpha concentrations ranged from 63 pCi/L (sample 1-MW-10-GU-P-02) to 13,739 pCi/L (sample 1-MW-08-GU-P-02) in AOC 1 and from 62.7 pCi/L (sample 2-MW-12-GU-P-02) to 4,877 pCi/L (sample 2-MW-02-GU-P-02) in AOC 2. Maximum gross beta concentrations were reported for the same sample locations, with averages of 66.4 pCi/L (sample 1-MW-10-GU-P-02) to 5,555 pCi/L (sample 1-MW-08-GU-P-02) in AOC 1 and 39.9 pCi/L (sample 2-MW-12-GU-P-02) to 1,722 pCi/L (sample 2-MW-12-GU-P-02) in AOC 2. As mentioned in the piezometer discussion, gross alpha and gross beta are expected to be present base on the presence of uranium in the groundwater.

No Ra-226 or Ra-228 values exceeded the combined radium 226/228 MCL of five pCi/L in the A aquifer. Average Ra-226 data was reported between 0.08 pCi/L and 0.58 pCi/L, while average Ra-228 concentrations were between 0.26 pCi/L and 1.56 pCi/L. Thorium isotopes were

detected in only a few samples, and ranged from 0.114 pCi/L for Th-228 to 0.161 pCi/L for Th-230.

The two B aquifer wells impacted by uranium also exhibited elevated gross alpha results. The average gross alpha concentration in sample 2-MW-03-GU-P-02 was 11,743 pCi/L, while the average concentration in 2-MW-05-GU-P-02 was reported as 67.8 pCi/L. To a lesser extent, elevated gross was also reported in wells 2-MW-16B and 2-MW-04B. Average gross beta results from the 2-MW-03B and 2-MW-05 samples were 7,674 pCi/L and 46.2 pCi/L, respectively. Ra-228 results exceeded the MCL for combined Ra-226/Ra-228 of five pCi/L in 2-MW-03-GU-P-02, with an average concentration of 5.1 pCi/L. Remaining Ra-226/Ra-228 data averaged 0.16 pCi/L to 0.69 pCi/L and 0.27 pCi/L to 0.94 pCi/L, respectively. Thorium isotopes were detected in only a few samples, most notable 2-MW-03-GU-P-02. An average Th-230 was reported in this sample of 3.93 pCi/L.

No radiochemical constituents exceeded MCLs in the C aquifer and no thorium isotopes were detected.

Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for tap water. Full data presentations are presented in Appendix H-2. Analytical results for chemical constituents are compared to background constituent concentrations in the background screening step of the BRA (CABRERA 2011b). The reader is referred to Appendix B of the BRA, Tables B-3-2 through B-3-6 for groundwater.

Metals

For the OU1 groundwater, two metals (cadmium and silver) were not detected in any samples, and eight were detected in less than 10% of the total samples. Three metals (antimony, arsenic, lead and manganese) had constituent concentrations above PRGs.

Antimony concentrations exceeded the Region 6 PRG of 0.015 mg/L in five wells, with a maximum concentration of 0.058 mg/L in sample 2-MW-115-GU-P-02. The PRG for arsenic (0.0004 mg/L) was exceeded 13 wells in the A aquifer. Three wells reported consistent

exceedances over the six sampling events, with the maximum concentrations reported in well 2-MW-26A (0.035 mg/L to 0.067 mg/L in sample 2-MW-26-GU-P-02). Lead was reported in three wells, with consistent PRG exceedances also observed in well 2-MW-26A (0.019 mg/L to 0.031 mg/L in sample 2-MW-26-GU-P-02). The PRG for lead is 0.015 mg/L. Manganese was reported above the PRG of 1.7 mg/L in one well, with concentrations ranging from 3.1 mg/L to 4.6 mg/L in sample 1-MW-21-GU-P-02.

In the B aquifer, antimony was detected in one well (0.022 mg/L, 1-MW-11-GU-P-02), while arsenic concentrations exceeded the PRG in 18 wells. T hree wells reported consistent exceedances over the six sampling events, with the maximum concentrations reported in well 2-MW-05B (0.024 mg/L to 0.052 mg/L in sample 2-MW-05-GU-P-02). Lead was reported in six wells, with consistent PRG exceedances detected in well 3-MW-14B (0.022 mg/L to 24 mg/L in sample 3-MW-14-GU-P-02). Manganese was reported above the PRG in seven wells, with consistent exceedances in three wells. The maximum concentrations were observed in well 3-MW-13B (9.4 mg/L to 16 mg/L in sample 3-MW-13-GU-P-02.

Manganese exceeded the PRG in the single C aquifer well, with concentrations in sample 2-MW-25-GU-P-02 ranging from 6.500 mg/L to 14 mg/L in three of the five sampling rounds.

Table 4-27 presents the data summary for those metal concentrations exceeding the respective PRG value.

BTEX Investigation

During the first quarter (July and August 2005) groundwater samples from OU 1 and OU 2 wells were collected for benzene, toluene, BTEX analysis. A total of 25 monitoring wells were sampled. MCLs were exceeded in selected wells for each of these constituents as follows: the MCL for benzene (five µg/L) was exceeded in 17 wells; the MCL for toluene (1,000 µg/L) was exceeded in six wells; the MCL for ethylbenzene (700 µg/L) was exceeded in 11 wells; and the MCL for xylene was exceeded in four wells. Two of the wells had elevated detection limits that exceeded the MCL, therefore, it cannot be stated with certainty. T he sampling results are summarized in Table 4-28. Figures 4-31 and 4-32 show the isopleths for total BTEX in the A and B aquifers at OU 1, respectively.

LNAPL Investigation

A sample of light non-aqueous phase liquid (LNAPL) was collected from well 2-MW-01B on October 13, 2005. The sample was shipped to Paragon Laboratory for VOC analysis, SVOC analysis and determination of total uranium. The sample contained 0.4 pCi/g total uranium which is within the range of local background concentrations.

Analysis for VOCs by Method 8260 showed that the LNAPL consisted of naphthalene (approximately 11%); 95,000 mg/kg xylenes (*meta-*, *para- & ortho-*) (10%); 52,000 mg/kg chlorobenzene (5%); 45,000 mg/kg 1,2,4-trimethylbenzene (4%); 920 mg/kg methylene chloride (3%); and 14,000 mg/kg 1,3,5-trimethylbenzene (2%). The remainder of the Method 8260 VOCs ranged from 580 mg/kg to 13,000 m/kg (0.8% to 3.3%) Analysis for SVOCs by Method 8270 showed 68,000 mg/kg naphthalene (approximately 7%) as well as 27,000 mg/kg 2-methylnaphthalene (3%) and a number of other polycyclic aromatic hydrocarbons (PAHs) and phenolics. Other SVOCs ranged from 81 mg/kg to 3,600 mg/kg (0.8% to 3%). Concentrations of detected organic compounds and uranium in the sample are listed in Table 4-29.

The LNAPL appears to be coal tar or coal tar distillate with a mixture of other compounds. Naphthalene compromises some 11% of typical coal tars (Gas Engineers Handbook, 1965), as is found in the LNAPL. Coal tar also typically contains arsenic (Hatheway, 2002), and elevated arsenic concentrations roughly correlate with the LNAPL location. The sample also contains the chlorinated solvents chlorobenzene and methylene chloride. Neither coal tar components nor chlorinated solvents are DuPont FUSRAP COPCs. Coal tar was historically used in dye production and coal tar distillation wastes have previously been identified by DuPont as COPCs during its RCRA correction action program at Chamber Works (DERS, 1995).

VOCS and SVOCs

VOCs were detected above the respective PRG levels in 12 wells in the A aquifer, with the highest concentrations and most frequently detected compounds being observed in four wells: 2-MW-19A, 2-MW-20A, 1-MW-21A and 1-MW-22A. Of these, the maximum concentrations of VOCs were reported in sample 2-MW-19-GU-P-02, with concentrations ranging from 140 µg/L to 20,000 µg/L. In the B aquifer, VOCs were detected above the PRG values in 11 wells, with the highest concentrations and most frequently detected compounds being reported in four wells:

2-MW-01B, 1-MW-07B, 1-MW-17B and 2-MW-23B. No VOCs were detected in the C aquifer well.

SVOC compounds were detected in only two wells in OU1, with one PRG exceedance in monitoring well, 1-MW-09B. T able 4-30 presents the data summary for those organic compound concentrations exceeding the respective PRG value.

5.0 OU 2 INVESTIGATION RESULTS

5.1 Site Characteristics

General site characteristics for the Chambers Works site are presented in Section 3.0; the information provided below is specific to OU 2 (AOC 3 and AOC 5) surface features, soils and hydrogeology.

5.1.1 Surface Features

AOC 3, the CDD, has a nearly linear shape, and the investigated length between OU 1 and the lagoon is nearly 1000 ft long and only 30 ft wide. Historical aerial photographs (before, during and after the MED operational period) show that part of the CDD, in the northern part of AOC 2, was re-routed in the 1950s. The southern end of the CDD east of the rail spurs was open water during the MED period. The other sections of the CDD were channelized and as a result, there was no lateral migration from the channel.

A wooden trough is the eastern boundary of AOC 1 and extends in a northwesterly direction and connects to the CDD in the northern part of AOC 1. T his structure is a part of AOC 3. Historical aerial photos indicate that the trough was in use during the MED era. Former Building 845 appears to have been connected to the wooden trough.

AOC 5 is completely paved by concrete or asphalt. The drains surrounding Building J-26 are open-topped trenches that are covered with slotted steel gratings. The drains are approximately one foot wide.

5.1.2 Soils

The soils beneath the CDD in AOC 3 consist largely of silts and clays to a depth of seven ft beneath the bottom of the ditch. The silt and clay layer averages six ft in thickness in the western end of AOC 3 but thins to zero toward the east in the area of the basins. Beneath the silt and clay layer is a continuous unit of sand and gravelly sand. Geologic cross sections in AOC 3 and a map showing their locations are presented in Figures 5-1 and 5-2.

The soils beneath the wooden trough consisted predominantly of black silts and clays, which are encountered from two ft to approximately seven ft beneath the trough bottom. Beneath this silt and clay layer are clean sands and gravelly sands.

The silty clay layer appears to be continuous in the area of AOC 3, except that it pinches out to the east in the lagoon area. This silty clay layer corresponds to the AB aquitard. The sands and sandy gravels below are the top of the B aquifer.

The soil textures beneath AOC 5 (Building J-26 Area) are similar in composition to the soils in AOC3. Soil textures were primarily silt with discontinuous clay stringers that were encountered from approximately three ft to nine ft bgs. However the silts and clays appear to be discontinuous and do not occur in some locations; such as at boring 5-SB-13 and perhaps in the area of borings 5-SB-03 and 5-SB-04. There was almost no rubble encountered in AOC 5. A geologic cross section (C-C') in AOC 5 is presented in Figure 5-2. The location of this cross section in AOC 5 is shown on Figure 5-3.

5.1.3 Site-Specific Hydrology

AOC 3 lies approximately 1,000 ft from the bank of the Delaware River. The CDD averages 30 ft in width at the top of its bank. It has an approximate elevation of sea level (zero ft NAVD 88) at the base of the ditch. The water flow direction of the CDD is eastward toward the B basin. The water depth in the ditch averaged one to two ft during August 2003. The CDD appears to exhibit perennial water flow. Groundwater seeps have been noted on the banks of the CDD.

A historical air-photo review of the CDD was conducted in order to determine the placement of the ditch from the 1940s to present. During the 1940s, in the area of AOC 3, the CDD consisted of two streams that converged just west of Kinetic Road. The eastern, downstream reach of the CDD was significantly different from its current run. Two railroad spurs traverse the CDD east of Kinetic Road. In the 1940s, the CDD opened into a ponded area near these spurs. East of the railroad spurs the CDD discharged into Lagoon A. The above information led to sampling both historic and present CDD locations, as discussed below in Section 5.2.

AOC 5 lies at an elevation of approximately five ft NAVD. The AOC 5 drains are used to collect storm water and direct it to the B Basin. The drains usually contain water and surges in flow are observable that indicate the use of pumps to feed water into the drain.

In AOC 3 and AOC 5, groundwater currently has a northeastward flow direction in the B aquifer, as shown in Figure 5-4**.** Contour maps of organic and metal contaminants in the B aquifer

indicate that the groundwater flow direction was probably to the north-northwest before the commencement of pumping from the IWS, installed in the 1970s (DERS, 1993, p.19). The most prominent B aquifer feature is a cone of depression and a large groundwater trough. The axis of the trough trends north-northwest to south-southeast across the plant. This trough is also most likely the result of a groundwater expression of paleochannel fill deposits that trend through the B aquifer (Geotrans, 1993). A drowned channel of the Delaware River is evident in aerial photographs and parallels the direction of the paleochannel, as shown in Figure 5-5.

The CDD appears to drain the A aquifer and locally controls groundwater flow within this aquifer. The CDD also appears to recharge the B aquifer in AOC 3. This same interaction between the aquifers and the drainage ditches has been observed in the southwest portion of Chambers Works (GeoTrans, 1993).

5.2 Study Area Investigation

This section presents detailed information for the soil and groundwater investigations conducted for OU 2. General information regarding investigative techniques, sampling methodologies and analytical requirements can be found in Section 2.0.

5.2.1 AOC 3, Central Drainage Ditch

5.2.1.1 Soil and Vadose Zone Investigations, AOC 3

A total of 39 soil borings were completed in AOC 3, as shown on Figure 5-6. The initial characterization included 27 borings placed along the centerline of the current CDD, the centerline of the wooden trough that runs along the northern border of AOC 1, and along the historical run of the CDD. An additional 10 geoprobe borings were installed in July 2007 to gather data in support of the BRA as well as to establish the relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations. Two soil borings related to monitoring well installation were also placed in AOC 3.

The CDD was originally a naturally occurring drainage feature that has been periodically moved, channeled, or enclosed in culverts. A historical photograph review showed that the downstream end of the CDD was wider in the late 1940s, so an additional six locations were selected to sample from the historical centerline of the CDD (see Figure 5-6).

The wooden trough was present in the 1940s and has been identified in historical records as being used for waste discharges from Former Building 845. T he wooden trough is a ditch excavated into the ground, having wooden sidewalls and a natural sediment bottom. It is approximately two ft wide and two ft deep. The upstream end of the wooden trough connects to the Historic Process Water Ditch System and the downstream end connects to the CDD. It has perennial water flow. Wooden stretchers or props are situated at distances of approximately every 20 ft to keep the sidewalls from caving in. The current appearance of the wooden trough suggests that it is of original construction.

One sediment soil sample (3-SS-28) was collected from an area of elevated gamma-count readings that was encountered during the GWS. Sediment sampling results are discussed later in Section 5.3.1.4.

A total of 20 soil samples were analyzed for TAL metals, VOCs, SVOCs, PAHs, PCBs, and pesticides. While these constituents are not COPCs for the DuPont Site based on the FUSRAP Eligible Contaminant List, they were analyzed for to provide information for the human health risk assessment

Soil Geotechnical Parameters

Soil samples were collected for the standard geotechnical parameters shown in Table 5-1. AOC 3 soils contained a large amount of silt and clay.

5.2.1.2 Groundwater Investigations, AOC 3

Groundwater samples were collected from 30 soil boring locations using temporary piezometers, as discussed in Section 2.5.1. Some of the locations were not sampled for groundwater because their proximity to other boring locations was judged to make the data redundant. These locations are discussed further in Section 5.3.1.3. Filtered and unfiltered aliquots were also collected from each location. Groundwater analysis parameters were collected and analyzed as described in Section 2.6.2.

Depth-to-water measurements were recorded and referenced to ground surface before groundwater sampling took place. After completion of groundwater sampling, the piezometers were abandoned by removing the casings and screens and filling the boring with bentonite slurry.

Temporary well point sampling records are provided in Appendix G. Two monitoring wells (3-MW-13 and 3-MW-14) were installed in AOC 3 but these wells and collected data are presented with OU 1 monitoring wells. Analytical results for samples collected from these wells are presented Section 4.3.5.2 of this report.

5.2.1.3 Surface Water and Sediment Investigations, AOC 3

A total of 13 surface water and 31 sediment samples were collected for radiological analysis. The surface water samples were analyzed for TAL metals, VOCs and SVOCs. A subset of the sediment samples (10) was analyzed for these constituents as well as for PCBs and PAH compounds. While these constituents are not COPCs for the DuPont Site, based on the FUSRAP Eligible Contaminant List, it was necessary to analyze for them to provide information for the BRA.

For sampling locations in the ditch, sediment samples were defined as the shallowest soil sample (zero to two foot sample interval) collected from each of the borings. Sample locations for both surface water and sediment, along with analytical results, are presented in Section 5.3.1.4.

5.2.2 AOC 5, Building J-26 Area (Former Building J-16)

5.2.2.1 Soil and Vadose Zone Investigations, AOC 5

A total of 11 soil borings were completed in AOC 5, as shown on Figure 5-7. The initial characterization had planned for a minimum of 15 boring locations in locations in or near former open drains or sewers. Three of the locations were approved; 12 locations were not approved due to the high density of subsurface utilities that are present in the areas of the former drains and sewers. According to DuPont personnel the drains were replaced by approximately four separate piped utility systems that were laid in the former drains. An open drain remains in use that runs along the northern side of Building J-26. Off-set positions were proposed, which were 10 ft from the locations of the former drains on average. Eight offset locations were approved by USACE and provided useful groundwater sampling locations that completely surrounded the Building J-26 Area. Figure 5-7 shows the completed sampling locations in AOC 5. The remaining off-set locations were not approved, since the offset would be too great to yield soil samples that would be representative of the former drains.

Soil Geotechnical Parameters

Soil samples were collected for the standard geotechnical parameters shown in Table 5-2. AOC 5 soils are fine-grained but contained less clay than soils encountered in AOC 3. All samples were collected from below the water table and were water-saturated.

The cross section for AOC 5 is presented in Figure 5-2 and shows the soil textures encountered beneath the former J-16 building area. The location of the cross section through the area is shown in Figure 5-3.

5.2.2.2 Groundwater Investigations, AOC 5

Filtered and unfiltered groundwater samples were collected from 10 boring locations using temporary piezometers, as discussed in Section 2.5.1. Analytical parameters are described in Section 2.6.2. In one location (5-SB-13), water recovery was not good enough to permit collection of both filtered and unfiltered samples.

Before sampling at each location, depth-to-water measurements were recorded. After completion of groundwater sampling, the piezometers were abandoned by removing the casings and screens and filling the boring with bentonite slurry. Temporary well point sampling records are provided in Appendix G-1.

Groundwater samples were also collected from the four existing DuPont groundwater monitoring wells at AOC 5 and analyzed for radiological constituents, as well as for TAL metals, VOCs and SVOCs to provide information for the interpretation of geochemical conditions, and in support of the BRA. These non-radiological constituents are not COPCs for the DuPont Site, based on the FUSRAP-Eligible Contaminant List. The locations of these wells are shown on Figure 5-7.

5.2.2.3 Surface Water and Sediment Investigations, AOC 5

There are no surface waters or sediments in AOC 5. There are storm drains and sewage lines, which are all lined with concrete or plastic. It is not known if these structures are cracked and leaking into the groundwater or vice versa (exfiltration or infiltration).

5.2.3 Ecological Investigation

A qualitative site visit was conducted at OU 2 in October 2003 and July 2007 to investigate the need for a radiological ecological risk assessment at the two AOCs. The results from the site

visit indicated that a screening level ecological risk assessment was warranted at AOC 3 but no ecological receptors and habitats were observed at AOC 5. With the exception of gulls flying high overhead, there were no animals (or plants) observed near the Building J-26 Area (AOC 5). This area is completely covered by pavement or buildings and therefore, no suitable habitat exists to attract ecological receptors. The site visits reports are included in Appendix O. The habitats, ecology, receptors, and exposure pathways observed at the CDD (AOC 3) during the site visits are described in Appendix O and are further evaluated in the Ecological Screening Risk Assessment.

5.3 Nature and Extent of Contamination

5.3.1 AOC 3, Central Drainage Ditch

5.3.1.1 Source Zones

The USEPA uses the term 'source' or 'source zone' to identify the area where a hazardous substance was first stored or released, or where "heavily-contaminated" media exist (USEPA, 1988). AOC 3 is therefore not considered to be a primary source zone for the purposes of this report. The CDD is considered a potential pathway for contaminant migration since it represents a drainage feature adjacent to former uranium-processing facilities.

The source zones for uranium found in AOC 3 are within OU 1. Soil contamination associated with Former Building 845 (in AOC 1) and Former Building 708 (in AOC 2) is discussed in Section 4.0.

5.3.1.2 Soils and Vadose Zone, AOC 3

A total of 39 soil borings were sampled in AOC 3. One sediment location was sampled based on GWS results. One hundred and eighty three primary samples plus duplicates and third-party splits were collected. Of this total, 138 samples were analyzed by onsite gamma spectroscopy for total uranium, while 55 samples were analyzed by offsite gamma spectroscopy. An additional 20 soil samples were analysed by offsite alpha spectroscopy. Seventy-one samples were analyzed for Ra-226 (gamma spectroscopy), 74 for Th-234 (gamma spectroscopy), 37 for Th-230 (alpha spectroscopy) and 20 for isotopic uranium (U-234, U-235 and U-238) via alpha spectroscopy. An additional 75 samples were analyzed for U-235 by gamma spectroscopy

Chemical constituents (TAL metals, VOCs, SVOCs, PAHs, and PCBs) were also analyzed for in a subset of 20 soil samples from AOC 3 in support of the BRA.

5.3.1.2.1 Radiological Constituents

Uranium

As discussed in Section 1.0, MED-related radiological contamination is limited to the isotopes of natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. Natural uranium consists of these three isotopes at the following activity fractions: 48.3% U-234, 3.4% U-235, and 48.3% U-238, while total uranium is the sum of all three isotopes. If the uranium is in a secular equilibrium condition, as displayed by the equal U-234 and U-238 activities above, total uranium may be estimated by measuring U-238 and multiplying the result by 2.1. U sing gamma spectroscopy, U-238 is reported via its decay daughter Th-234 (and converted to total uranium using the multiplier above for direct comparison with the ISV of 14 pCi/g). T he calculated total uranium value was used to define the extent of soil potentially contaminated above the ISV, as discussed below. Analytical results for total uranium from both the onsite and offsite laboratories are presented in Table 5-3. T he maximum concentration reported for any sample (onsite or offsite analysis; alpha or gamma spectroscopy) is presented in the text and depicted on a ssociated figures. A brief summary of the isotopic U and Th-234 results is also provided in this section, while the analytical results are presented along with analytical data results for the other eligible radiological contaminants Ra-226 and Th-230. This data evaluation process was used throughout Sections 4, 5, and 6 for presentation of radiological soils data.

Sixty-one of the Th-234 samples were non-detect (82%). Detectable concentrations ranged from 1.9 pCi/g to 138 pC i/g. The 20 s amples analyzed for U-234 ranged from 0.38 pC i/g to 169 pCi/g, while the U-238 samples contained similar concentrations (0.308 pCi/g to 178 pCi/g). The U-235 alpha spectroscopy samples were between 0.22 pCi/g and 9.5 pCi/g. Eighty-nine percent (67 of 75 samples) were reported as non-detects for the U-235 gamma spectroscopy samples, while detected concentrations ranged from 0.44 pC i/g to 8.1 pC i/g. T he maximum concentrations of these isotopes were detected in one of the same sample locations (3-SB-39-BS-P-04) for which an uranium concentration above the ISV was detected as discussed below.

Horizontal Extent of Potential Uranium Contamination

The GWS indicated areas of elevated surface gamma activity near 3-SB-04, 3-SB-11, and 3-SB-22, as shown in Figure 5-8. One sediment sample was obtained in the area of 3-SB-22 and is further discussed in Section 5.3.1.4.1. Locations that exhibited elevated surface gamma activity levels and were in areas known to contain MED uranium were not sampled (e.g. 3-SB-04). With the exception of these discrete areas, the GWS indicated that the surface gamma activity was less than a Z-Score of three, and no biased samples were obtained.

Vertical Extent of Potential Uranium Contamination

Analytical results for total uranium from the soil samples collected from AOC 3 are listed in Table 5-3. Ten of the 183 samples (5%) had uranium activities above the ISV of 14 pCi/g, with concentrations ranging from 14.7 pCi/g to 365 pCi/g. Figure 5-9 is a map showing the highest total uranium activity encountered at each boring location. As previously noted the maximum reported result from either the onsite or offsite laboratory is shown at each sample location with the corresponding depth information. For the basis of defining potentially contaminated soils, the data are presented against the ISV since it was the screening threshold used during the course of field work. Figures 5-10 and 5-11 present a cross sectional view of the vertical depth of uranium contamination above the ISV in the wooden trough area and the main channel of the CDD, respectively.

The majority (seven of 10 locations) of the elevated uranium was detected in the eastern portion of the CDD in current or former ditch locations. This portion of the CDD also exhibited deeper potential soil contamination (up to eight ft bgs) than the locations in the western and southwestern portions of the CDD. The maximum concentration of 365 pCi/g was reported in sample 3-SB-39-BS-P-04 at a depth of four to five ft bgs. This boring was located to the east of the current drainage ditch and south of the historic drainage ditch in the vicinity of the lagoon (as outlined in Figure 5-1). The location is believed to have been inadvertently placed in a closed DuPont disposal cell area, SWMU 16, the Former C Basin as shown on Figure 5-12. The berm of the disposal cell was built up over the years with dredge spoils from the lagoon. The berm can best be observed on Figure 5-6 in relation to both boring 3-SB-39 and the current lagoon location. While no additional AOC 3 soil samples exist to the east of this location for use in

bounding potential soil contamination, it should be noted that the field effort was constricted in this area due to the presence of the disposal cell and that there are additional soil sampling locations through the center of AOC 4 (OU 3) which demonstrate that no uranium is present in the historical lagoon area (as discussed in Section 6.3.1). It is should be noted that the sampling results from 3-SB-39 are reported in this RI but were excluded from the nature and extent determinations and evaluation in the BRA.

Other boring samples with total uranium concentrations above the ISV in the eastern portion of AOC 3 include 3-SB-19-B-0-03 (four to six ft depth) and 3-SB-36-BS-P-05 (39.3 pCi/g and 22 pCi/g, respectively) in the six ft depth, and samples 3-SB-20-B-0-04 (six to eight ft depth); 3-SB-26-B-0-04; and 3-SB-37-BS-P-06 at the seven ft depth (33.7 pCi/g, 41 pCi/g and 33.4 pCi/g, respectively). The presence of deep soil contamination in this area is most likely a result of historical lagoon deposits in the mid-1940's, followed by subsequent filling operations during periods of construction. The western edge of the lagoon (circa 1945) extended across the surface area where these RI soil borings were located. All potentially contaminated soils were located at discrete depths within each boring.

The remaining three locations with uranium soils exceeding the ISV were in the western to southwestern portion of the CDD, as shown on Figure 5-9. Exceedances ranged from 15.3 pCi/g at the zero to two ft depth (sample 3-SB-09-B-0-01) to 35.3 pCi/g (sample 3-SB-05-B-0-02 (two to four ft bgs). Figures 5-10 and 5-11

Other Radiological Constituents

The maximum soil concentrations for the remaining radiological constituents were co-located in one of the borings in the eastern portion of the CDD which contained elevated total uranium values. Sample 3-SB-37-BS-P-06 contained the maximum concentrations of Ra-226 (3.83 pCi/g and Th-230 (11.2 pCi/g). Total uranium in this sample was 33.4 pCi/g. The remaining soil sample concentrations for Ra-226 were between 0.35 pCi/g and 1.92 pCi/g, while the Th-230 concentrations ranged from 0.304 pCi/g to 10.9 pCi/g. Table 5-4 presents the analytical results for the radiological isotopic samples, while Figure 5-13 shows the distribution of results across AOC 3.

5.3.1.2.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRG for residential soil, where applicable. As mentioned in Section 4.0, these PRGs were chosen for use because they represent the most recently updated human health screening values and in most cases are more conservative than the values published in the State of NJ standards. Full data presentations are located in Appendix F. Table 5-5 presents a summary of the metals constituents that exceed the PRG values, while Tables 5-6 and 5-7 present summaries of VOC/SVOC and PAH/PCB compounds, respectively. In addition, analytical results for chemical constituents are compared to background constituent concentrations in the background screening step of the BRA (CABRERA 2011b). The reader is referred to Appendix B of the BRA, Tables B-1-2 through B-1-6 (Surface Soil) and Tables B-2-2 through B-2-7 (All Depth Soil).

Metals

Sixteen metals were detected in over 95% of the 20 soil samples. Two metals were detected in 55%-65% of the (selenium and sodium, respectively), while the remaining five metals (antimony, beryllium, cadmium, mercury and silver) were detected in less than nine samples (less than 45%). A total of five of these metals have concentrations that exceeded the respective PRG, as discussed below.

Arsenic was reported above the PRG of 0.39 mg/kg in 18 soil samples, with concentrations ranging from 1.3 mg/kg (3-SB-38-SS-P-00) to 25 mg/kg (3-SB-30-SS-P-00). Chromium and lead were detected above the PRGs with the next highest frequencies (five and seven samples, respectively). The maximum concentrations of both metals were reported in 3-SB-36-BS-P-05 (chromium: 140 mg/kg and lead: 54,000 mg/kg). The PRG for chromium is 30.1 mg/kg, while the PRG for lead is 400 mg/kg. Antimony and mercury also exceeded their respective PRG values (31 mg/kg and 6.1 mg/kg) in two soil samples, with the maximum concentrations detected in 3-SB-37-BS-P-06 (170 mg/kg antimony and 14 mg/kg mercury). Metal exceedances in soils were co-located with elevated uranium in only five of the 18 samples.

VOCs and SVOCS

VOCs were detected in 11 of the 20 soil samples, with one PRG exceedance. Benzene was reported at a concentration of 3,600 µg/kg (PRG of 656 µg/kg) in sample 3-SB-36-BS-P-05. The single SVOC PRG exceedance was also reported for the same soil sample (390 µg/kg hexachlorobenzene; PRG of 340 µg/kg). This location contained elevated uranium at the same sample depth (four to six ft bgs). It should be noted that several SVOC compounds, such as chrysene or benzo(a)anthracene, are also reported as PAHs (PAHs are a subset of SVOCs and analyzed by different methodologies). Thus, these compound are presented in the PAH discussion below.

PAHs, PCBs and Pesticides

PAH compounds were detected in all 20 soil samples, with depths ranging from one to eight ft. PAHs were detected above the PRGs with greatest frequency (five exceedances) and with the highest reported concentrations in four soil boring locations: 3-SB-31, 3-SB-32, 3-SB-35 and 3-SB-36. The maximum PRG exceedances reported for these four locations were:

- 3-SB-31-SS-P-00: 600 µg/kg benzo(b)fluoranthene (PRG of 148 µg/kg),
- 3-SB-32-SS-P-00: 2,800 µg/kg benzo(b)fluoranthene
- 3-SB-35-SS-P-00: 1,400µg/kg benzo(b)fluoranthene
- 3-SB-36-BS-P-05 : 1,000 µg/kg benzo(b)fluoranthene

One PCB compund (Aroclor-1260) was detected in 11 of the 20 soil samples, with four PRG exceedances. These concentrations ranged from 270 µg/kg in 3-SB-36-BS-P-05 to 11,000 µg/kg in 3-SB-32-SS-P-00. The PRG value for Aroclor-1260 is 222 µg/kg.

The maximum PAH and PCB constituents were detected in conjunction with elevated levels of uranium in approximately 50% of the samples.

5.3.1.3 Piezometer Sampling Results, AOC 3

Of the initial 27 soil borings installed in August 2003, piezometers were installed and groundwater sampled from 21 of these locations. The remaining six locations (3-SB-16, 3-SB-18, 3-SB-21, 3-SB-22, 3-SB-23 and 3-SB-26) were judged to be in such close proximity to other soil borings that they would be redundant for groundwater quality measurements. Eight piezometers were installed in July 2007 to gather additional analytical data in support of the BRA. A total of 30 samples were analyzed for isotopic and total uranium, gross alpha / gross

beta, Ra-226/Ra-228 and isotopic thorium. Thirty samples were analyzed for TAL metals and eight for VOCs.

Groundwater was generally encountered at approximately two ft bgs in the borings not installed in the ditch. For borings within the ditch, the groundwater level was the same as the water level in the ditch. The groundwater level in the piezometers recovered very slowly, therefore the measured water levels should not be considered as true static measurements.

AOC 3 Groundwater Geochemistry

Groundwater stabilization parameters were measured for unfiltered samples during the purging of each sampling point. These included pH, specific conductance, temperature, ORP, turbidity and DO. In addition, groundwater was analyzed at the time of purging for concentrations of ferrous iron, nitrite, sulfide and sulfate. Water quality data representing stabilized conditions are presented in Table 5-8, while the results for the additional sampling parameters are provided in Table 5-9. No stabilization or geochemical parameters were obtained for the additional eight piezometer locations and samples collected for risk assessment purposes. These locations are 3-SB-30, 3-SB-32, 3-SB-34, 3-SB-35, 3-SB-36, 3-SB-37, 3-SB-38, and 3-SB-39.

Generally, the unfiltered samples exhibited high turbidity, with the exception of three samples which stabilized to less than 10 NTUs Turbidity ranged from one to 592 NTUs. DO concentration ranged from 0.41 mg/L to 9.9 mg/L and averaged 4.5 mg/L, while ORP values ranged from 3.3 mV to 234 mV and averaged 169 mV. Both DO and ORP values indicate oxidizing conditions in the B aquifer, contrary to the reducing conditions found in OU1 groundwater. Specific conductance averaged 2,321 µS/cm, with values ranging from 470 µS/cm to 8,260 µS/cm. Groundwater pH for AOC 3 ranged from slightly acid to circum-neutral (4.9 to 7.9) and averaged 6.6.

Geochemical parameters measured from the unfiltered samples were similar in concentration to those reported in the filtered samples. Average ferrous iron values were 1.47 mg/L for both types of samples. Filtered sample results ranged from 0.01 mg/L to 2.9 mg/L; while unfiltered sample values ranged from 0.1 mg/L to 2.85 mg/L. Nitrite was detected infrequently and at low levels, with an average concentration of 0.01 mg/L for both filtered and unfiltered samples.

Sulfide values were also low (less than one mg/L), averaging 0.09 mg/L in filtered samples and 0.14 mg/L in unfiltered samples. These low levels support the presence of an oxidizing environment. The sulfate concentrations ranges indicate slightly reducing to slightly oxidizing conditions, with values ranging from zero mg/L to 53 mg/L in unfiltered samples and zero mg/L to 64 mg/L in filtered samples. The average concentrations of sulfate from both types of samples, unfiltered and filtered, were 17 mg/L and 18 mg/L, respectively.

Major Ions in Groundwater

Groundwater samples were analyzed for major cations and anions to determine their effects on uranium geochemistry. Concentrations of the inorganic ions chloride, nitrate, phosphate (as orthophosphate), and alkalinity were also measured. Sample results for major cations and anions in AOC 3 are presented in Table 5-10. Groundwater samples from locations 3-SB02, 3-SB-03 and 3-SB-10 were not analyzed for cations and anions.

In general, ionic concentrations from the unfiltered samples were slightly higher than those from the filtered ones. Chloride concentrations averaged 366 mg/L for filtered samples and 387 mg/L for unfiltered samples. The maximum chloride concentration (1,500 mg/L) was reported in unfiltered sample 3-SB-24-G-0-01. For comparative purposes, the NJDEP WQC for chloride is 250 mg/L. Nitrate and phosphate values were low and detected infrequently (four detects in unfiltered samples; no detects in filtered samples). Average concentrations for both constituents were less than one mg/L. The maximum nitrate value (2.3 mg/L) was detected in unfiltered sample 3-SB-20-G-0-01. The maximum reported phosphate concentration (2.5 mg/L) was also in unfiltered sample 3-SB-24-G-0-01. The alkalinity values reported in the B aquifer are indicative of "hard" water quality. With the exception of one sample (3-SB-15-G-0-02; 23 mg/L unfiltered), alkalinity values ranged from 130 mg/L to 440 mg/L in unfiltered samples (average of 209 mg/L); and 71 mg/L to 380 mg/L in filtered samples (average of 210 mg/L).

5.3.1.3.1 Radiological Constituents

Uranium

Isotopic and total uranium activities in both filtered and unfiltered groundwater samples are shown in Table 5-11. Total uranium results exceeding the MCL of 30 µg/L have been highlighted. These exceedances have been utilized to determine the nature and extent of

groundwater contamination and are the focus of the discussions presented below. As discussed in previous sections, the uranium results reported by the laboratory as pCi/L have been converted to mass units of µg/L by dividing the result by a factor of 0.667 to allow comparison to the MCL.

As noted in Section 4.0, the USEPA MCLs are drinking water standards and thus are intended to be applied to representative filtered samples. Samples from temporary piezometers may contain suspended particulates and are not always considered to be "representative". While filtering the piezometer sample may assist in yielding a fairly representative groundwater geochemical sample, these samples are compared to Federal standards for screening purposes only.

Uranium concentrations were consistently higher in the unfiltered samples than in the filtered sample. The maximum total uranium at location 3-SB-14 was reported as 601 µg/L (compared to the MCL of 30 µg/L). The next highest uranium values were reported in unfiltered samples from 3-SB-01 (83.7 µg/L). Location 3-SB-39 also contained elevated levels of uranium compared to the remaining sample locations, with a total uranium concentration of 37.0 µg/L. In contrast, the majority of the filtered samples were less than one pCi/L, and the maximum total uranium concentration for filtered samples was 7.75 µg/L in 3-SB-14. Results for total uranium in filtered groundwater and unfiltered groundwater are presented in Figure 5-14.

While the turbidity of sample 3-SB014 was recorded as seven NTUs, it is believed that the anomalously high uranium concentration in the unfiltered sample from 3-SB-14 is the result of sediment being entrained into the water sample. The sampling method utilized four L of water preserved with nitric acid, which should dissolve metals in any entrained sediment. The uranium concentration in soil at 3-SB-14 was four pCi/g at six ft bgs, which equates to six mg of uranium per kg of soil. The water sample contained 401 pCi/L uranium, which equates to 600 µg/L (0.6 mg/L). This volume can be translated to 0.15 mg/L uranium contained in the four L sample. The amount of entrained soil that would contain 0.15 mg uranium is 0.025 kg or 25 grams of soil, which could easily be entrained in a four L sample of water. The maximum conductivity value and chloride concentration were also reported in this location.

Other Radiochemical Analyses

In addition to uranium, groundwater samples were analyzed for gross alpha, gross beta, Ra-226, Ra-228 and thorium isotopes. Results are listed in Table 5-12 and presented in Figure 5-15.

For those radionuclides with corresponding MCL values, the results exceeding the respective MCL have been shaded. Analytical results for filtered gross alpha indicate that one filtered sample (3-SB-13; 18.8 pCi/L) exceeded the MCL of 15 pCi/L, versus 11 unfiltered samples. Unfiltered concentrations ranged from 1.1 pCi/L to 860 pCi/L (3-SB-14). Gross beta activity was also reported at higher concentrations in the unfiltered samples, with a maximum value of 1,120 pCi/L ((3-SB-14). The presence of both gross alpha and gross beta can be attributed to the presence of uranium in the groundwater samples. The maximum filtered sample concentration was reported as 22.8 pCi/L in 3-SB-8. The combined Ra-226/Ra-228 MCL of five pCi/L was exceeded in three of the unfiltered samples, with an average concentration of 1.86 pCi/L Ra-226 and 1.55 pCi/L Ra-228. No exceedances were observed in the filtered sample results (average of 0.38 pCi/L Ra-226 and 0.95 pCi/L Ra-228). Thorium isotopes were analyzed for a subset of the unfiltered samples (eight of 30). No Th-228 or Th-230 was reported, and the Th-232 values were between 0.032 pCi/L and 0.044 pCi/L.

5.3.1.3.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRG for tap water. Full data presentations are presented in Appendix H-2. Table 5-13 presents a summary of metals concentrations in groundwater samples from the temporary piezometers that exceed the PRG values for tap water. Table 5-14 presents a summary of VOCs and SVOCs.

Metals

Of the 23 TAL metals, nine were reported above the PRG in filtered and unfiltered samples, and one metal (mercury) had a single PRG exceedance in an unfiltered sample. The majority of the PRG exceedances were detected in unfiltered samples.

Antimony was reported above the PRG of 0.015 mg/L in a total of 12 samples. The maximum concentration (0.11 mg/L) was detected in unfiltered sample 3-SB-19-G-0-02, whereas the

maximum concentration in a filtered sample was 0.053 mg/L in sample 3-SB-17-G-0-01. Arsenic exceeded the PRG of 0.00004 mg/L in a total of 37 samples, 13 of which were filtered. The maximum arsenic concentrations in unfiltered samples were 0.31 mg/L in sample 3-SB-01-G-0-02 and 0.42 mg/L in 3-SB-01-G-1-04. Chromium was reported above the PRG of 0.11 mg/L in six samples, all unfiltered. The maximum concentration of 0.46 mg/L was detected in sample 3-SB-12-G-0-2.

VOCs and SVOCs

Both VOCs and SVOCs were detected in all eight samples analyzed. Five locations had a higher occurrence of several contaminant compounds exceeding their respective PRGs (3-SB-32; 3-SB-34; 3-SB-36 and 3-SB-37 and 3-SB-38). Of these, the highest concentrations were detected in sample 3-SB-34-GU-P-12, with a maximum value of 10,000 µg/L chlorobenzene (PRG of 91.3 µg/L).

5.3.1.4 Surface Water and Sediment Results, AOC 3

5.3.1.4.1 Radiological Constituents

Uranium

Comprehensive sample results for both isotopic and total uranium for the surface water samples obtained in AOC 3 are presented in Table 5-15. Of the 13 surface water samples, no total uranium was detected above the USEPA MCL of 30 µg/L. The maximum reported total uranium value was 3.37 µg/L in 3-SW-13-SW-P-00.

Sediment results for total uranium are provided in Table 5-16, with values in excess of the ISV (14 pCi/g) highlighted. A brief summary of the isotopic uranium and thorium results for sediment is provided below; analytical results are in tables along with other eligible radiological contaminants. Laboratory data for both primary and QA analysis (surface water and sediment) are presented in Appendix P.

In sediment samples, 14 of the 17 Th-234 gamma spectroscopy samples were non-detect (82%). The three samples with detectable concentrations of Th-234 ranged from 3.5 pCi/g to 14.8 pCi/g. The 10 samples analyzed for U-234 and U-238 (alpha spectroscopy) ranged from 0.24 pCi/g to 5.28 pCi/g and 0.44 pCi/g to 4.92 pCi/g, respectively. Four of the 10 U-235 alpha spectroscopy samples were non-detect, while concentrations of detected U-235 ranged from 0.03 pCi/g to 0.22

pCi/g. Eighty-eight percent of the samples (15 of 17) were reported as non-detects for the U-235 gamma spectroscopy samples, while the two detectable concentrations reported as 0.84 pCi/g and 1.02 pCi/g.

Of the 31 sediment samples analyzed for total uranium, 36% (or 11 samples) were reported as non-detects. Six samples from three locations exceeded the ISV of 14 pCi/g, with all but one (3-SS-28) of these exceedances being reported from two locations within the 'wooden trough' area of the CDD. The elevated uranium concentrations in the 'wooden trough' area (3-SB-02 and 3-SB-04) ranged from 18.8 pCi/g (sample 3-SB-02B-0-01) to 98.2 pCi/g (sample 3-SB-04-B-0-06 (zero to two ft in depth)).

The sediment sample collected from location 3-SS-28 was a biased sample collected due to elevated activity identified during the walkover and analyzed for gamma-spectral activity in the on-site lab. The sample came from a unit that was visually distinct from the soil surrounding it. This unit was a one half inch thick lens of black, silt-sized material with no measurable organic vapor (as measured by PID) or visible organic sheen. Total uranium activity in this sample was 79.6 pCi/g (sample 3-SS-28-R-0-01 (zero to 0.5 ft in depth). This sample was submitted for SEM and XRD for mineral analysis. The assemblage of minerals detected in 3-SS-28 was consistent with fluorspar feedstock used to manufacture hydrofluoric acid. A DuPont hydrofluoric acid production area was once located north of the area in which this sample was collected. Additionally, the location of sample 3-SS-28 is near DuPont's SWMU 34, where gyp-cake wastes from hydrofluoric acid production were disposed. It is therefore believed that 3-SS-28 represents possible DuPont radioactive material, based on mineralogy and location, and is unrelated to MED. A further discussion on the SEM/XRD analysis is presented in Section 7.0, Fate and Transport and the reports describing the SEM/XRD analytical results are presented in the Appendix R.

In the sediments from the other sampling locations in the CDD, total uranium activities ranged from 0.45 pCi/g to 10.1 pCi/g. Figures 5-16 and 5-17 present sediment and surface water sample results, respectively, for total uranium in AOC 3.

Other Radiological Constituents

In addition to radiochemical analysis for uranium described above, all 13 surface water samples were analyzed for the radiochemical parameters gross alpha / gross beta, Ra-226/Ra-228. Ten surface water samples were analyzed for thorium isotopes Th-228 and Th-230. Radionuclide results for surface water are presented in Table 5-17. Analytical results for gross alpha suggests below MCL (15 pCi/L) concentrations in all samples analyzed. The maximum gross alpha concentration reported was 5.1 pCi/L in sample 3-SW-13-SW-P-00. The maximum gross beta concentration (26.7 pCi/L) was also detected in sample 3-SW-13-SW-P-00. The presence of both gross alpha and gross beta is most likely attributable to the presence of uranium and radium in the surface water samples. Radium-226 was detected in three samples with values between 0.25 pCi/L and 0.35 pCi/L while Ra-228 was not detected in any surface water sample in AOC 3. No Th-228 was detected; while one Th-230 value was reported for sample 3-SW-04-S-P-00 (0.1 pCi/L). Figure 5-17 presents the distribution of surface water sample results in AOC 3.

Seventeen sediment samples were analyzed for Ra-226 and Th-234, while 20 samples were analyzed for Th-230. Sediment results are presented in Table 5-18. Sediment results for Ra-226 ranged from 0.37 pCi/g to 0.92 pCi/g. Th-230 concentrations were reported between 0.15 pCi/g and 1.37 pCi/g. Fourteen of the 17 samples for Th-234 were reported as non-detects. Of the remaining samples, the highest concentrations were reported in samples 3-SB-04-B-0-01 (14.8 pCi/g) and 3-SB-02-B-0-01 (9.2 pCi/g). These are the same sediment locations containing the maximum total uranium concentrations (with the exception of 3-SS-28). Figure 5-18 presents the results of the sediment sampling for the ROPC constituents.

5.3.1.4.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those surface water and sediment constituents for which concentrations have exceeded the USEPA Region 6 PRG for tap water or residential soil, respectively. Full data presentations are presented in Appendix P. Table 5-19 presents a summary of the constituents that exceed the PRG values for surface water, while Table 5-20 presents an exceedance summary for sediment. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the

BRA, Tables B-4-2 through B-4-4 (Surface Water) and Tables B-5-2 through B-5-6 (Sediment) presents these results.

Metals

Lead was the only metal in any of the surface water samples for AOC 3 which exceeded the PRG. The concentrations of lead ranged from 19 µg/L (sample 3-SW-08-SW-P-00) to 250 µg/L (3-SW-10-SW-P-00), compared to a PRG of 15 µg/L.

Of the three metals which exceeded PRGs in the sediment (arsenic, chromium and lead), arsenic was detected with the greatest frequency (Table 5-20). This metal was reported above the PRG of 0.39 mg/kg in eight sediment samples, with concentrations ranging from 1.5 mg/kg (3-SD-07-SD-P-00) to 51 mg/kg (3-SD-06-SD-P-00). Chromium and lead were detected in the same four sediment samples, with a maximum chromium value of 65 mg/kg in 3-SD-10-SD-P-00 and a maximum lead concentration of 2,900 mg/kg in 3-SD-06-SD-P-00. The PRG for chromium is 30.1 mg/kg; the PRG for lead is 400mg/kg. None of the sediment samples where elevated metals were detected contained uranium above the ISV.

VOCs and SVOCs

VOCs were detected in 10 surface water samples. The maximum reported VOC concentration was 130 µg/L carbon tetrachloride in sample 3-SW-07-SW-P-00. The PRG for this compound is 0.171 µg/L. The SVOC 1,4-dichlorobenzene was detected in five surface water samples, with reported values being estimated concentrations (i.e., 'J' qualified). The maximum reported concentration was 6.8 µg/L in sample 3-SW-08-SW-P-00. The PRG value for 1,4 dichlorobenzene is 0.467 µg/L.

VOCs were detected in three of the 10 sediment samples. Benzene was reported at a concentration of 1,500 µg/kg in sample 3-SD-08-SD-P-00. The PRG for this compound is 656 µg/kg. The compound 1,4-dichlorobenzene was reported in sample 3-SD-06-SD-P-00 at a concentration of 64,000 µg/kg and at 10,000 µg/kg in sample 6-SD-07-P-00, compared to the PRG of 3,200 µg/kg. Carbon tetrachloride and chloroform were also reported above the respective PRGs in sample 3-SD-06-SD-P-00. None of the samples were co-located with potentially contaminated uranium sediments. No SVOCs were detected above the PRGs.

PAHs and PCBs

PAH compounds exceeded PRGs in all 10 sediment samples with a maximum concentration of 5,100 µg/kg benzo(b)fluoranthene in 3-SD-05-SD-P-00. The PRG value for this compound is 148 µg/kg. One PCB compund (Aroclor-1260) was detected in seven sediment samples. The concentrations ranged from 380 µg/kg in 3-SD-08-SD-P-00 to 62,000 µg/kg in 3-SD-04-SD-P-00. The PRG value for Aroclor-1260 is 222 µg/kg. None of the samples were co-located with potentially contaminated uranium sediments.

5.3.2 AOC 5, Former Building J-16

5.3.2.1 Source Zones

The Former Building J-16, which housed the Jackson Laboratories, is a potential source zone in AOC 5. The former drains that comprise AOC 5 once surrounded former Building J-16, which performed batch tests of uranium refining processes. These former drains are considered a potential pathway for contamination migration since it represents a drainage feature adjacent to former uranium-processing facilities. Based on review of aerial photos, the footprint of Former Building J-16 was approximately 4,000 square feet (ft^2). Building J-16 was demolished and replaced by the larger, presently-existing Building J-26. The debris from J-16 was removed as well as was "several feet of earth" (Weston, 2001).

5.3.2.2 Soils and Vadose Zone, AOC 5

A total of 11 soil borings were completed in AOC 5. Sixty-one primary samples plus duplicates and third-party splits were collected from these borings. All 61 soil samples were analyzed by on-site gamma spectroscopy for total uranium, while 22 of the samples were also analyzed for total uranium at an off-site laboratory by gamma spectroscopy. These 22 samples were also analyzed for U-235, Ra-226 and Th-234 (gamma spectroscopy). Eleven samples were analyzed for Th-230 (alpha spectroscopy).

5.3.2.2.1 Radiological Constituents

Uranium

As previously discussed, characterization results for total uranium were compared to the ISV of 14 pCi/g in order to define the extent of potential soil contamination. A brief summary of the isotopic uranium results is provided here; analytical data results are presented in tabular format along with the other eligible radiological contaminants Ra-226 and Th-230. Twenty-one of the

22 Th-234 samples were non-detect (95%); the reported concentration was 1.13 pCi/g. All of the U-235 gamma spectroscopy samples were reported as non-detect, with reporting limits between 0.28 pCi/g to 0.61 pCi/g.

Horizontal Extent of Potential Uranium Contamination

A GWS was not conducted in AOC 5 because of the thickness of the asphalt paving and the density of metallic signal interference both in the subsurface and overhead. Since site history data indicate that the near-surface has been extensively excavated and backfilled, the value of a GWS would have been minimal. The characterization of horizontal extent therefore depends on the shallow soil-boring data.

Ten soil samples were acquired from the zero to two foot depth interval in AOC 5, and the analytical results for all of these samples indicate uranium activities below the ISV.

Vertical Extent of Potential Uranium Contamination

Of the 61 soil samples collected from AOC 5 soil borings, analytical results for 82% of those analyzed onsite for total uranium (53 samples) reported non-detect (ND) results, with reporting limits ranging from 0.67 pCi/g to 1.13 pCi/g. Only one of the 22 samples analyzed off-site contained detectable concentrations of uranium (5-SB-05-B-0-05, 2.3 pCi/g) None of the samples contained total uranium concentrations that exceeded the ISV of 14 pCi/g.

Table 5-21 presents analytical results for total uranium in AOC 5 soils, while Figure 5-19 is a map showing the highest total uranium activity encountered in each boring.

Other Radiological Constituents

The concentrations for Ra-226 ranged from 0.3 pCi/g to 1.44 pCi/g, while the Th-230 concentrations were between 0.217 pCi/g and 0.87 pCi/g. Table 5-22 presents the analytical results for the radiological isotopic samples, while Figure 5-20 shows the distribution of results across AOC 5 and Figure 5-21 shows the vertical extent of total uranium results across AOC 5.

5.3.2.3 Piezometer Results, AOC 5

Groundwater was encountered in AOC 5 borings at approximately four ft bgs, although as with AOC 3, the measured levels may not have been truly static. Groundwater samples were

collected from all borings, with the exception of boring 5-SB-13. Due to low water recovery at this location, an unfiltered groundwater sample could not be collected.

AOC 5 Groundwater Geochemistry

Table 5-23 lists results for pH, conductivity, temperature, ORP, turbidity and DO from the piezometers after purging. Table 5-24 lists results for major (reactive) ions results acquired from onsite measurements.

The samples exhibited high turbidity, ranging from 81.6 NTUs to 978 NTUs. Dissolved oxygen concentration ranged from 0.46 to 6.93 mg/L and averaged 2.74 mg/L. ORP ranged from -254 to 236 mV and averaged 50 m V. In general, field parameter results indicate that AOC 5 groundwater exhibits somewhat reducing conditions.

Specific conductance averaged 2,288 microSiemens per meter (µS/m), with values ranging from 10 µS/m to 5,590 µS/m. Groundwater pH at AOC 5 ranged from 6.8 to 7.9.

With the exception of sulfate, unfiltered samples exhibit higher levels for geochemical parameters. Average ferrous iron values were 0.50 mg/L for unfiltered samples, and 0.24 mg/L for filtered. Nitrite was detected infrequently and a low levels, with an average concentration of 0.01 mg/L and 0.043 mg/L for unfiltered and filtered samples, respectively. Sulfide values were also low (less than one mg/L), averaging 0.03 mg/L in unfiltered samples and 0.01 mg/L in filtered samples. The sulfate concentrations ranged from zero mg/L to 37 mg/L in unfiltered samples and zero mg/L to 73 mg/L in filtered samples. The average concentrations of sulfate from both types of samples were eight mg/L and 19 mg/L, respectively.

Groundwater samples were analyzed for major cations and anions to determine their effects on uranium geochemistry. Concentrations of the inorganic ions chloride, nitrate, phosphate (as orthophosphate), and alkalinity were measured. Sample results for major cations and anions in AOC 5 are presented in Table 5-25.

In general, analytical results from the unfiltered samples were similar to those reported in the filtered samples. Chloride concentrations averaged 390 mg/L for filtered samples and 384 mg/L for unfiltered samples. The maximum chloride concentrations (1,200 mg/L filtered and 1,100

mg/L unfiltered) were reported for location 5-SB-10. For comparative purposes, the NJDEP WQC for chloride is 250 mg/L. Nitrate was not detected in either set of samples, while phosphate was detected in one filtered and four unfiltered samples. The maximum reported phosphate concentration (4.5 mg/L) was reported for the unfiltered sample from 5-SB-10. The alkalinity values reported in the B aquifer are indicative of "hard" water quality. Alkalinity values ranged from 92 mg/L to 740 mg/L in filtered samples (average of 240 mg/L); and 75 mg/L to 760 mg/L in unfiltered samples (average of 239 mg/L). The highest alkalinity values were also reported in 5-SB-10.

5.3.2.3.1 Radiological Constituents

Uranium

Isotopic and total uranium activities in both filtered and unfiltered groundwater samples are shown in Table 5-26. Total uranium results exceeding the USEPA MCL of 30 µg/L have been highlighted. These exceedances have been utilized to determine the extent of groundwater contamination, and are the focus of the groundwater discussion below. The uranium results reported by the laboratory as pCi/L have been converted to mass units of µg/L by dividing the result by a factor of 0.667 to allow comparison to the MCL.

Uranium concentrations were consistently higher in the unfiltered samples than those from the filtered samples. The maximum isotopic uranium values were reported in the unfiltered sample 5-SB-03-G-0-01. Uranium-234 was reported as 20.1 pCi/L; U-235 as 0.91 pCi/L; and U-238 as 16.7 pCi/L. Total uranium concentration at this location was reported to be 51.3 µg/L (compared to the MCL of 30 µg/L). The next highest uranium values were reported in unfiltered samples from 5-SB-07-G-0-01 (U-234, 9.3 pCi/L and total uranium, 29.7 µg/L). In contrast, total uranium levels from a majority of the filtered samples were less than one pCi/L, with a maximum level of 2.08 µg/L in the sample from location 5-SB-11-G-0-01. Results for total uranium in filtered and unfiltered groundwater from the temporary piezometers are presented in Figure 5-22.

Other Radionuclides

In addition to uranium, groundwater samples were analyzed for gross alpha, gross beta, Ra-226 and, Ra-228. Results are listed in Table 5-27 and presented in Figure 5-23. For those

radionuclides with corresponding MCL values, the results exceeding the respective MCL have been shaded. Analytical results for filtered gross alpha indicate that one filtered sample (5-SB-10; 5.5 pCi/L) exceeded the MCL of 15 pCi/L, versus six for unfiltered samples. Unfiltered concentrations exceeding the MCL ranged from 28.1 pCi/L to 406 pCi/L (5-SB-07). Gross beta activity was also reported at higher concentrations in the unfiltered samples, with a maximum value of 510 pCi/L (5-SB-07). The maximum filtered sample concentration of 21.2 pCi/L was also detected in this location. The elevated levels of gross alpha and gross beta are most likely attributable to the presence of both uranium and radium in the groundwater samples. The combined Ra-226/Ra-228 MCL of 5 pCi/L was exceeded in eight of the unfiltered samples. No exceedances were observed in the filtered sample results. Concentrations were highest for Ra-226, with a maximum value of 27 pCi/L. The maximum Ra-228 value was 16 pCi/L. Both maximum values were reported in 5-SB-07.

5.3.2.3.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations exceed the USEPA Region 6 PRG for tap water. Full data are presented in Appendix H-1. Table 5-28 presents a summary of the compounds that exceed the PRG values for tap water.

In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-3-2 through B-3-6 presents these results for groundwater.

Metals

Two metals (arsenic and iron) were reported at levels above the PRG in filtered samples and nine in unfiltered samples. The maximum concentrations of all metals in unfiltered samples were observed in sample 5-SB-07-G-0-01.

DNAPL

A DNAPL was encountered at boring 5-SB-15. The DNAPL layer was at a depth of 9.5 ft bgs and appeared to have a thickness of approximately three inches. The layer was perched on a

low-conductivity clay unit of unknown thickness. The clay unit was not completely penetrated by the boring, which was completed at 10 ft bgs.

5.3.2.4 Monitoring Well Results, AOC 5

Uranium

Four DuPont monitoring wells were sampled for isotopic and total uranium in July 2007. Sample results for isotopic and total uranium in theses wells are presented in Table 5-29 and Figure 5-24. Groundwater laboratory data for both primary and QA analysis are presented in Appendix H-2.

No total uranium results exceeded the MCL of 30 µg/L. The maximum total uranium concentration detected in the four wells was 1.29 µg/L in Well C08-M01B, compared to the MCL of 30 µg/L. Isotopic uranium values were reported at concentrations less than one pCi/L.

Other Radionuclides

In addition to analysis for uranium described above, groundwater samples were analyzed for the radiochemical parameters gross alpha / gross beta, Ra-226, Ra-228, and the thorium isotopes Th-228, Th-230 and Th-232. Radionuclide results are presented in Table 5-30 and in Figure 5-25.

No gross alpha concentrations exceeded the MCL of 15 pCi/L. The maximum concentration reported was 11.9 pCi/l in Well C08-M01B. Gross beta concentrations ranged from 8.4 pCi/L (Well C08-M01B) to 56.9 pCi/L (Well D07-M01B). Again the presence of gross beta is most likely attributed to uranium and radium. No Ra-226 or Ra-228 concentrations exceeded the MCL for combined Ra-266/Ra-228 of five pCi/L. Radium-226 data was reported at less than one pCi/L and Ra-228 values were non-detect. The thorium isotopes Th-228, (thorium decay series), Th-232 and Th-230 (uranium decay series) were detected infrequently and at low levels. Thorium-228 and Th-232 were each detected in two samples, while Th-230 was detected in only one sample. Reported values were less than one pCi/L.

Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for tap water. Full data presentations are presented in Appendix H-2. Table 5-31 presents a summary of metals exceeding a respective

PRG value, while Table 5-32 presents a summary of VOCs and SVOCs. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-3-2 through B-3-6 presents these results.

Metals

Six metals were not detected in any samples from the four DuPont wells sampled in AOC 5, and seven were detected in only one well, (C08M01B-GU-23). Arsenic concentrations exceeded the Region 6 PRG of 0.00048 µg/L in three wells with the maximum concentration (0.082 mg/L) reported in well C08M01B-GU-23. Lead was reported above the PRG of 0.015 mg/L in CO8-M01B-GU-23 (0.022 mg/L).

VOCS and SVOCs

VOCs were detected above the respective PRG levels in all four wells, with the highest concentrations and most frequently detected compounds being observed in B Aquifer well C08M01B. Concentrations in this well ranged from 30 µg/L methylene chloride to 2,200 µg/L 1,2-dichlorobenzene (sample C08M01B-GU-23). A aquifer well D08M01A reported the next highest frequency of detections, with PRG exceedances ranging from 21 µ g/L 1,4-dichlorobenzene to 1,600 µg/L 1,2-dichlorobenzene (sample C08M01A-GU-P-09).

SVOCs were reported with the greatest frequency and highest concentrations in the same two wells. S VOC concentrations in sample C08M01B-GU-23 ranged from 26 µ g/L 1,3-dichlorobenzene to 1,100 µg/L 1,2-dicholorobenzene and from 12 µg/L 1,4-dicholorobenzene to 1,200 µg/L 1,2-dicholorobenzene in sample C08M01A-GU-P-23.

6.0 OU 3 INVESTIGATION RESULTS

6.1 Site Characteristics

General site characteristics for the Chambers Works site are presented in Section 3.0; the information provided below is specific to OU 3 (AOCs 4 and 6) surface features, soils and hydrogeology.

6.1.1 Surface Features

AOC 4 (Historical Lagoon A) is located in the northern portion of the site, and is bounded by the Delaware River seawall to the north, Plant No. 1 Road to the south, Kinetic Road to the west and Boundary Road to the east, as shown on Figure 1-2. The sea-wall, which is a sheet steel erosion barrier, rises approximately three ft above ground surface. The southern half of AOC 4 is covered by gravel, while the northern half is covered by grass. Ground surface slopes down toward the north, with the high point being the road that forms the southern boundary, at an elevation of five ft above sea level, and the low point being approximately one foot above sea level where the ground surface meets the sea wall.

AOC 6 is bounded by (and includes) East Road to the south and the 'C' Landfill to the north. A drainage ditch runs from west to east across the northern section of the area. Ground surface elevation is six ft above sea level at East Road, and seven ft above sea level north of the drainage ditch. The bottom of the drainage ditch is approximately 2.5 ft above sea level. AOC 6 is largely unpaved bare soil, except for East Road, which is asphalt.

6.1.2 Soils

In AOC 4, the soil textures encountered from the ground surface to approximately five ft bgs are fine-grained sand and silty sand, with occasional clay stringers and debris. This upper unit is considered to be part of the A Aquifer. Organic clay and silt were encountered from approximately 10 to 12 ft bgs, which corresponds to the A-B Aquitard. Below 12 ft bgs, fining-upward fine- to medium-grained sands were encountered, corresponding to the B Aquifer. Like the A Aquifer, this sand unit contained occasional clay stringers.

Soil textures in AOC 6 consist mainly of sand and gravelly sand with silt and clay stringers. The sand unit is fining-upward and is at least 50 ft thick. This unit corresponds to the B Aquifer. Neither the A Aquifer nor the A-B Aquitard is present in AOC 6.

6.1.3 Site-Specific Hydrology

Within AOC 4, the groundwater flow direction in the A Aquifer is toward the Delaware River (i.e., northwest), while the groundwater flow direction in the B Aquifer appears to be toward the southeast as a result of DuPont's operation of the IWS. Soil textures are variable in the A Aquifer because these soils consist of debris, fill, and waste. Discounting the debris and waste, the average soil texture is fine-grained silty sand.

The depth to groundwater in the AOC 6 water table aquifer (the B Aquifer) is approximately 10 ft bgs. Groundwater flow is to the southwest, toward a DuPont recovery well. Surface water flows to the east through the ditch that traverses the area. Water flows through the ditch in the eastern part of AOC 6 intermittently, during storm events.

6.2 Study Area Investigation

6.2.1 AOC 4, Historical Lagoon A

6.2.1.1 Soils and Vadose Zone, AOC 4

Soil sampling in AOC 4 was conducted in a phased approach. The initial investigation (November 2004) consisted of installing 63 soil borings using CPT and assessing soils for radiological contamination. Based on the results of the CPT sampling, eight soil borings were installed in November 2005 using a rotosonic drilling method. An additional 10 Geoprobe borings were installed in July 2007 to gather data in support of the BRA as well as to establish the relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.

Details regarding the implementation of each sequence of the soils investigation are presented below; details on sampling methodologies and analytical parameters are presented in Section 2.0. In addition to the soils investigations, borings were drilled in May 2006 for the installation of five monitoring wells in AOC 4 as part of a supplemental groundwater investigation. Soil samples were collected and analyzed during the drilling and the associated results are presented below in conjunction with the CPT, rotosonic and Geoprobe subsurface investigations.

Information on the groundwater samples obtained from the monitoring wells is provided in Section 6.2.1.2.

Cone Penetrometer Testing Investigation

USACE selected 60 CPT locations in AOC 4. The locations were spaced approximately every 200 Ft around the periphery of Lagoon A and along the dikes separating each basin. CPT locations were also placed within both AOIs within AOC 4: AOI 1 (DuPont SWMU 5) and AOI 6 (MED rubble-disposal area). USACE added three boring locations based on the results of GWS. CPT soundings were advanced at all 63 locations to a maximum depth of 20 ft bgs. PVC pipes were installed into the open soundings to allow for in-situ spectral-gamma logging of the subsurface. Of the CPT boring locations within AOC 4, a total of 11 required multiple pushes to set the PVC sleeve. Of those 11 multiple-push sites, one sounding (4CPT62) resulted in refusal. At the completion of the gamma logging, the coordinates of each boring location were verified using a Trimble ProXRS GPS System. Figure 6-1 shows the CPT locations in AOC 4.

Soil texture logs were generated for each CPT location. The texture logs were generated electronically using data from force gauges that measured tip and sleeve resistance on the penetrometer as it was advanced through the subsurface. Tip-versus-sleeve force ratios were correlated with different soil textures in accordance with established ASTM standards. Soil boring logs are presented in Appendix C, with copies of the CPT data and associated soil texture logs located in Appendix C-2. These logs were used to construct a geological cross-section for AOC 4, which is presented in Figure 6-2. In AOC 4, fill material was encountered to a depth of approximately eight ft bgs.

In-situ spectral-gamma logging was also performed at each of the CPT locations, as described in Section 2.0. Graphic representations of each boring's gamma spectral data are presented in Appendix B-2. A report summarizing the results of the spectral gamma logging is also included in Appendix B-2. None of the boreholes exhibited radioactivity higher than observed background levels at any of the depth intervals evaluated, based on gamma logging results. At the direction of the USACE, five CPT locations were selected for soil sampling and analysis. Based on the results of the CPT *in-situ* spectral-gamma logging, AOIs 1 and 6 were identified for further investigation, as discussed below.

Rotosonic Drilling Investigation

A total of eight borings were advanced by rotosonic drilling in AOC 4 to facilitate the delineation of specific areas of contamination identified during the CPT investigation: four borings on the north side of the lagoon in AOI 1 and four borings on the east side of the lagoon in AOI 2. The locations of the AOIs that required additional investigation through the soil boring program locations are shown on Figure 6-3. Borings were advanced to maximum depth of 15 ft bgs.

Geoprobe Investigation

A total of 10 soil borings were advanced using Geoprobe direct push technology to target uranium source areas where the total uranium concentrations were expected to be approximately 100 pCi/g. The intent of specifying a uranium concentration of 100 pCi/g was to target areas with mid-range concentrations of uranium in order to evaluate and compare alpha spectroscopy and gamma spectroscopy results. Prior to this investigation, alpha spectroscopy results showed either very low concentrations combined with non-detects, or significantly higher results (i.e., greater than 100 pCi/g). Therefore, the goal of the Geoprobe investigation was to target those mid-range concentrations of uranium in order to obtain a complete range of concentrations for the evaluation. Soil boring locations are shown on Figure 6-1. Borings were installed to a maximum depth of 10 ft.

6.2.1.2 Groundwater Investigations, AOC 4

Expedited Uranium Investigation

An expedited groundwater investigation was conducted in the spring of 2006 to identify the horizontal and vertical extent of the uranium contamination in groundwater in AOC 4. The investigation was conducted using a Geoprobe to sample for groundwater in the A and B aquifers. Detailed methodology is presented in Section 2.0. In general, an unbiased sampling grid was designed based on concentric circles centered on the one known location of uranium impact to groundwater in this AOC; the A aquifer well I17-M01A. Sampling results obtained during the Quarters 2 and 3 sampling at this location had indicated total uranium concentrations between 192 µg/L and 200 µg/L (as presented in subsection 6.3.1.2).

A total of 26 sampling locations were spaced approximately 75 ft apart, along a sampling grid based on concentric circles. Geoprobe sampling points were advanced to 10 ft bgs, which is in the A aquifer in this area. A sample of unfiltered groundwater (10 mL) was collected and analyzed onsite using inductively coupled plasma – mass spectrometry. Only 20 of the proposed 26 locations in the grid needed to be completed before the dissolved uranium area had been fully-delineated. The other six proposed locations were found to be outside the established site screening-level iso-concentration contour for total uranium of 20 µg/L. The 20 µg/L screening level (66.7% of the USEPA MCL of 30 µg/L) allowed for a safety factor due to heterogeneities in sample results inevitably caused by subsurface conditions.

Of the 20 water samples collected from the Geoprobe locations, five had non-detectable uranium concentrations (less than one µg/L), 11 had uranium concentrations between one µg/L and 30 µg/L, and three had uranium concentrations greater than 30 µg/L. The maximum detected concentration of uranium was 460 µg/L [307 pCi/L] at sample location 4-GP-01. The area of uranium contaminated groundwater is approximately 250 ft long and 175 ft wide.

An additional sampling location (4-GP-27) was advanced downgradient of well I17-M01A beneath the aqueous uranium area to provide additional vertical delineation of uranium impact. The groundwater sample was collected from a depth of 44 ft bgs, which was interpreted to be the base of the B Aquifer. The sample had a non-detectable uranium concentration.

Groundwater screening sample results are summarized in Table 6-1; and total uranium concentrations based on the screening results are presented in Figure 6-4.

Monitoring Well Investigation

The Geoprobe sampling results were used to plan the locations of five monitoring wells, four in the A aquifer and one in the B aquifer, to delineate uranium contamination. Monitoring well construction and installation details are presented in Section 2.0. Wells 4-MW-02, 4-MW-05, 4-MW-06, and 4-MW-07, were installed in the A Aquifer while well 4-MW-01 was installed in the B Aquifer. Monitoring well locations are presented in Figure 6-5. Soil boring logs and well construction diagrams are presented in Appendix C-3. Well development records are provided in

Appendix G. In addition, three existing DuPont wells (H17-MO2B; I17-P01A; and I17-MO1A) were included in the monitoring well investigation and are shown on Figure 6-5.

Absolute pressure gauge transducers were placed in four of the AOC 4 wells (4-MW-01, 4-MW-02, 4-MW-05, and I17-M01A) and used from 17 May 2006 to 8 June 2006. The transducers recorded water levels and groundwater temperatures at 30 minute intervals. Data from the absolute gauges were adjusted for changes in atmospheric pressure using the weather data gathered from the onsite weather gauge. The results were used to determine the effect of tides on AOC 4, AOI 1 groundwater. The tabulated weather/transducer data are presented in Appendix Q. The transducer data indicate that the A Aquifer in AOC 4 is hydraulically connected to the Delaware River, while the B Aquifer is much less so.

6.2.2 AOC 6, East Burial Area

6.2.2.1 Soils and Vadose Zone. AOC 6

Soil sampling in AOC 6 was also conducted in a phased approach. Sixty five borings were completed using CPT while 23 borings were installed using the rotosonic drilling method. Two borings were hand augered and an additional 10 borings were advanced with a Geoprobe.

Details regarding the implementation of each phase are presented below; details on sampling methodologies and analytical parameters are presented in Section 2.0. Three borings completed as monitoring wells were also drilled as part of the rotosonic drilling investigation. An additional three monitoring well borings were drilled in May 2006 as part of a supplemental groundwater investigation. Soils were collected and analyzed during the drilling and the soil analytical results are presented in conjunction with the CPT, rotosonic and Geoprobe subsurface investigations. Information on the groundwater samples obtained from the monitoring wells is provided in Section 6.2.2.3.

Cone Penetrometer Investigation

USACE selected 60 CPT locations in AOC 6. The locations were established based on the approximate extent of seven suspected disposal areas (AOIs 1-7) for building rubble and other debris identified during the review of historical aerial photography. Within each suspected debris disposal area, a grid pattern was established with CPT locations spaced approximately every 60 ft. USACE added three boring locations based on the results of the initial GWS, and

then added two locations based on preliminary results from the downhole gamma logging. CPT borings were advanced at all 65 locations to a maximum depth of 20 ft bgs. At the completion of the gamma logging, the coordinates of each boring location were obtained using a Trimble ProXRS GPS System. Figure 6-6 shows the CPT locations and associated AOIs within AOC 6.

The area north of East Road exhibited several areas of heavy rubble during CPT activities. Boring locations in the vicinity of 6CPT18, 6CPT62 through -64, and 6CPT35 required multiple pushes to set the PVC sleeve. Only two instances of refusal were encountered in AOC 6: one each at 6CPT09 and 6CPT23. Soil texture logs generated during the AOC 6 CPT investigation are presented in Appendix C-2. These logs were used to construct a geological cross section for AOC 6, which is presented in Figure 6-7. It should be noted that the AB Aquitard is discontinuous in AOC 6; only the B Aquifer is present. Fill material was encountered to a depth of approximately eight ft.

In-situ spectral gamma logging was performed at each of the AOC 6 CPT locations. Graphic representations of each boring's gamma spectral data are presented in Appendix B-2. A report summarizing the results of the spectral gamma logging is also included in Appendix B-2.

Elevated levels of radiological constituents were noted in four of the in-situ gamma logged holes. The predominant radiological constituent identified in two of the holes (6CPT02 and 6CPT05) was potassium-40 (K-40), most likely resulting from a potassium-rich waste. The other two holes (6CPT21 and 6CPT37) were identified as having elevated refined natural uranium at levels below the ISV of 14 pCi/g, with a maximum observed concentration of 10 pCi/g. The spectral data for 6CPT21 and 6CPT37 are presented in Figure 6-8. Based on the results of the CPT *in-situ* gamma logging, AOI 4 (East Road area) and AOI 6 (Fire Fighter Training Area) were identified for additional investigations, as described below.

Rotosonic Drilling Investigation

The 25 borings installed via rotosonic drilling located in AOC 6 are shown in Figure 6-9 along with the additional Geoprobe sample locations. These 25 borings were selected to facilitate the delineation of specific areas of contamination identified during the CPT soil investigation. Four borings were located in AOI 6, while 21 borings were placed in AOI 4. The location of the AOIs

in AOC 6 are shown in Figure 6-10. Borings were advanced to maximum depth of 15 ft bgs. It should be noted that two of the planned boring locations could not be accessed with the drilling rig because of their close proximity to the East Road ditch (6-SB-17 and 6-SB-18). Borings were advanced near (15 ft from) these locations and identified as SB-17A and SB-18A. The original locations were then investigated using hand augers to a depth six ft bgs, at which depth flowing sands flowed into the boreholes. Since many of the borings in AOC 6 were located in roadways and paved areas, painting the ground was the primary means of field identification.

Geoprobe Investigation

An additional 11 soil borings were advanced in July 2007 using Geoprobe direct push technology to target uranium source areas where the total uranium concentrations were expected to be approximately 100 pCi/g. As discussed in Section 6.2.1.1 for the AOC 4 Geoprobe investigation, this mid range concentration of uranium was targeted for alpha and gamma spectroscopy comparisons. Geoprobe boring locations (6-SB-31 – 6-SB-41) are shown on Figure 6-9 (along with the rotosonic boring locations). As shown, 10 of the borings were centered in AOI 4, with the remaining Geoprobe location targeting a source area north of the ditch (AOI6). Borings were installed to a maximum depth of 10 ft.

6.2.2.2 Groundwater Investigation, AOC 6

Three monitoring wells, 6-MW-01, 6-MW-02, and 6-MW-03, were installed in AOC 6 in May 2005. They were installed in the B Aquifer to a depth of approximately 20 ft bgs. The monitoring well locations are presented in Figure 6-11. Soil boring logs and well construction diagrams are provided in Appendix C.

These wells were initially sampled during the third quarter sampling event in January 2006. Analytical results showed that Well 6-MW-01 had a uranium concentration of 763 µg/L, compared to the MCL of 30 µg/L. Based on this elevated result, an expedited characterization was planned to identify the nature and extent of the uranium in the groundwater at AOC 6. Further results for AOC 6 monitoring wells are discussed in Section 6.3.2.3.

Expedited Uranium Investigation

A groundwater investigation was conducted in June 2006 to identify the horizontal and vertical extent of uranium contamination in groundwater at AOC 6. The extent of uranium contamination was investigated using a Geoprobe to sample groundwater in the B Aquifer. Groundwater screening sample results are summarized in Table 6-2; and total uranium results are presented in Figure 6-11. Detailed field methods are described in Section 2 of this report.

Three Geoprobe explorations (6-GP-01, 6-GP-02, and 6-GP-03) were advanced in areas surrounding monitoring well 6-MW-01, to define the horizontal extent of the aqueous uranium. This location was selected for further characterization based on the quarter 3 sampling result of 763 µg/L uranium (as presented in subsection 6.3.2.3.). The sampling depth for these locations was 14 ft bgs, which is four ft below the water table. Uranium concentrations at these groundwater screening locations ranged from less than one µg/L to 14 µg/L, which are below the established site screening-level of 20 µg/L. The 20 µg/L screening level (66.7% of the MCL of 30 µg/L) allowed for a safety factor due to heterogeneities in sample results inevitably caused by subsurface conditions. While the screening level value was used to determine need for additional Geoprobe locations, the MCL of 30 µg/L was used to identify the extent of uranium impact.

A fourth Geoprobe boring (6-GP-04) was installed next to monitoring well 6-MW-01 at a depth of 44 ft bgs in order to delineate the vertical extent of uranium impact. The groundwater sample from this depth did not contain uranium at a detection limit of one µg/L.

Monitoring wells 6-MW-04, 6-MW-05, and 6-MW-06 were installed at the Geoprobe locations for 6-GP-01, 6-GP-02, and 6-GP-03, respectively, to confirm the horizontal extent of uranium impact. Well construction details are presented in Section 2.0 and Appendix C.

Monitoring well 6-MW-07 was located beside 6-MW-01 and advanced to a depth of 50 ft bgs to provide unfiltered water samples. It was screened at the base of the B Aquifer, as evidenced by the continuous sand units that were encountered during its installation. Soil boring logs and well construction diagrams are provided in Appendix C. Well development records are provided in Appendix G.

6.2.2.3 Surface Water and Sediment Investigation, AOC 6

A total of 12 surface water and 13 sediment samples were collected for radiological analysis. Ten of the 12 surface water samples were also analyzed for TAL metals, VOCs and SVOCs. Ten sediment samples were analyzed for these constituents as well as for PCBs and PAH compounds. While these constituents are not COPCs for the FUSRAP investigation based on the definition of FUSRAP-eligible contaminants, they were collected to provide information for the BRA.

6.3 Nature and Extent of Contamination

6.3.1 AOC 4, Historical Lagoon A

6.3.1.1 Source Zones

The source of contamination in AOC 4 is believed to be from both the process waste setting basin (former lagoon) that received effluent from the CDD and in the form of contaminated rubble, equipment and materials that were disposed after demolition of uranium-production buildings. In particular, the source of uranium contamination in AOI 1 (DuPont SWMU 5) is believed to be waste from Former Building J-16. Historical data indicate that much of the site was developed on top of construction fill resulting from onsite building demolition. It should be noted that the field effort was constricted in this area due to the presence of the disposal cell in SWMU 5 and that there are additional soil sampling locations in AOC 3 (to the west of SWMU 5) for use in bounding potential source zones related to AOC 4.

6.3.1.2 Soils and Vadose Zone, AOC 4

Soil samples were obtained from a total of 28 soil borings in AOC 4. Fifty-one soil samples plus duplicates and third-party splits were collected from these borings. All soil samples were analyzed for total uranium (31 by gamma spectroscopy and 20 by alpha spectroscopy), Th-234, U-235 (gamma spectroscopy), and Ra-226 (all gamma spectroscopy analysis), while 30 samples were analyzed Th-230 (alpha spectroscopy). Twenty samples were analyzed for isotopic uranium (U-234, U-235 and U-238) via alpha spectroscopy. All 51 samples were analyzed for U-235 by gamma spectroscopy.

Chemical constituents (TAL metals, VOCs/ SVOCs), PAH and PCB compounds) were also analyzed in a subset of 20 of soil samples from AOC 4 in support of the BRA.

6.3.1.2.1 Radiological Constituents

Uranium

As discussed in Section 1.0, MED-related radiological contamination is limited to the isotopes of natural uranium (U-234, U-235, and U-238) and their short-lived decay progeny. Natural uranium consists of these three isotopes at the following activity fractions: 48.3% U-234, 3.4% U-235, and 48.3% U-238, while total uranium is the sum of all three isotopes. If the uranium is in a secular equilibrium condition, as displayed by the equal U-234 and U-238 activities above, total uranium may be estimated by measuring U-238 and multiplying the result by 2.1. Using gamma spectroscopy, U-238 is reported via its decay daughter Th-234 (and converted to total uranium using the multiplier above for direct comparison with the ISV of 14 pCi/g). The calculated total uranium value was used to define the extent of potential soil contamination. Analytical results for total uranium from both the offsite laboratory alpha and gamma spectroscopy analyses are presented in Table 6-5. The maximum concentration reported for any sample (alpha or gamma spectroscopy) is presented in the text and depicted on associated figures. A brief summary of the isotopic U and Th-234 results is also provided in this section, while the analytical results are presented along with analytical data results for the other eligible radiological contaminants Ra-226 and Th-230.

Forty-one of the Th-234 samples were non-detect (80%). Detectable concentrations ranged from 3.9 pCi/g to 5,720 pCi/g. The 20 samples analyzed for U-234 ranged from 0.16 pCi/g to 23.6 pCi/g; while the U-238 samples contained similar concentrations (0.32 pCi/g to 23.6 pCi/g). The U-235 alpha spectroscopy samples were between 0.11 pCi/g and 1.25 pCi/g. Eighty-six percent (44 of the 51 samples) were reported as non-detects for the U-235 gamma spectroscopy samples. The detected concentrations ranged from 0.77 pCi/g to 282 pCi/g. The maximum concentrations of these isotopes were reported in two of the same sample locations for which uranium concentrations above the ISV were detected (4-CPT-62A-B-P-05 and 4-SB-34-BS-P-07), as discussed below.

Horizontal Extent of Potential Uranium Contamination

In AOC 4, the GWS encompassed the perimeter of the historical lagoon on the south, east, and north boundaries. A total of 18.7 acres was surveyed within this AOC. A portion of the

southwest side of the lagoon was omitted due to the presence of significant amounts of recently-emplaced fill material, which attenuated potential gamma influence from MED-era radioactivity deposits. Of the 55,493 data points collected, 54,287 data points (98%) exhibited calculated Z-Scores below the action level of three. Of the remaining data points, the highest calculated Z-Score was 18, which corresponded to a count rate of 29,853 cpm. The mean count rate for all of AOC 4 was 5,309 cpm, with a standard deviation of 1,389 cpm. A Z-Score of three encloses 99.73% of a normal population, therefore the portion of a normal population expected to exceed the upper limit confidence interval is calculated as [(100%-99.73%)/2] or 0.135%. In other words, of the 55,493 data points collected, 0.135% or 75 data points would be expected to exceed the Z-Score of three. The observed number of exceeding data points was 1,206, and therefore, 1,131 data points or 2.04% exceeded a normal distribution.

A graphic representation of the AOC 4 GWS is presented in Figures 6-12. The regions of highest surface gamma activity were located in the vicinity of 4CPT61, 4CPT63, and between 4CPT50 and 4CPT51. These areas were investigated further in an attempt to discern the source of the elevated gamma measurements.

At the region of elevated count rates near 4CPT61 and 4CPT63, a piece of uranium-impacted rubber debris measuring approximately four inches across was found at approximately seven inches bgs. This piece of debris was removed from the area for sampling and it was reported to contain a total uranium concentration of 11,700 pCi/g (4CPT62A B-P-05).

Upon investigation of the area around 4CPT50, it was noted that the ground surface consisted primarily of granitic gravel fill, as opposed to the dolomitic gravel cover typically found at DuPont. Granite typically contains approximately 40 becquerels per kilogram (Bq/kg; one pCi/g) uranium and 70 Bq/kg (1.9 pCi/g) thorium (Van Schmus, 1995). Thus, it was concluded that the elevated gamma activity in this region was likely due to the naturally occurring radioactivity of the granitic gravel rather than MED contamination. This conclusion was supported by a field test which consisted of placing the granitic gravel from the roadbed in a bucket, transporting it to a low-background count area and then scanning the granitic material with a FIDLER. Similarly elevated readings were reproduced from the granitic gravel during this testing as were detected during the GWS.

Vertical Extent of Potential Uranium Contamination

During the rotosonic drilling in AOI 1 (DuPont SWMU 5), it was noted that the upper 10 ft of soil consisted of sandy fill material and burial debris. Below 10 ft bgs, the soil consisted of native organic clay with sand stringers. Gross gamma background readings in the sand ranged from 4000 to 4500 cpm, while background gamma activity in the native clay ranged from 5000 to 7000 cpm. The higher gamma activity in the native clay is likely due to naturally occurring K-40. In AOI 2, sands and clays interpreted as fill persisted to at least 13 ft bgs. Gross gamma activities in this soil ranged from 4500 to 6500 cpm. Tables 6-3 and 6-4 show the gross gamma results for the AOC 4 borings. All measurements were integrated over a one minute count period.

Of the 51 soil samples collected from AOC 4 soil borings, analytical results for total uranium in 22 samples (or 43%) were reported as ND, with reporting limits ranging from two to eight pCi/g, as presented in Table 6-5. With the exception of the surficial debris sample discussed above (4CPT62A B-P-05), seven soil samples contained total uranium concentrations at depth that exceeded the ISV of 14 pCi/g, Figure 6-13 shows the highest total uranium activity encountered at each boring location.

All locations exhibiting potentially contaminated soils were located in the AOI 1 (DuPont SWMU 5) area of AOC 4. All potential soil contamination was at discrete intervals within each boring. Four of the seven samples exhibited potentially contaminated soils at depths between seven and 10 ft bgs. These locations also contained the highest concentrations of uranium reported for AOC 4. Boring 4-MW-06 contained a reported uranium concentration of 355 pCi/g at eight ft bgs (sample 4-MW-06-B-P-08) and 4-SB-23 (sample 4-SB-23-BS-P-09) contained uranium at 108 pCi/g at a depth of 9.5 ft bgs. Lower concentrations of uranium were detected at depths of eight to 9.5 ft bgs in borings 4-SB-34 (4-SB-34-BS-P-07; 48.3 pCi/g) and 4-SB-24 (4-SB-24-B-P-09; 21.3 pCi/g). Figure 6-14 presents a cross sectional view of the vertical extent of uranium contamination about the ISV across AOC 4.

The remaining three locations contained less elevated concentrations of uranium at shallower depths (less than 3.5 ft bgs). The shallower soil ISV exceedances were detected in borings 4-SB-

25 (sample 4-SB-25-B-P-03; 23.2 pCi/g); boring 4-SB-26 (sample 4-SB-26-B-P-03; 14.8 pCi/g) and boring 4-MW-05 (sample MW-05-B-P-03; 14.6 pCi/g).

Table 6-5 presents the analytical results with ISV exceedances shaded. Table 6-6 shows estimates of total uranium results from FIDLER readings in soil versus depth for AOC 4 soil borings (curves) versus analytical results from the offsite laboratory ("square" data points).

Other Radiological Constituents

The maximum concentrations of the other radiological constituents analyzed in AOC 4 soil borings were collocated with uranium in two of the sample locations. Sample 4-MW-06-B-P-08 contained the maximum concentrations of Ra-226 (4.42 pCi/g) and Th-230 (26.4 pCi/g). As presented above, total uranium in this sample was 355 pCi/g. Sample 4-SB-34-BS-P-07 contained the second highest concentrations of Ra-226 and Th-230 (4.01 and 17.1 pCi/g, respectively). Total uranium in this sample was 48.3 pCi/g.

The remaining soil sample concentrations for Ra-226 ranged from 0.46 pCi/g to 3.06 pCi/g., while the remaining Th-230 concentrations ranged from 0.09 pCi/g to 2.31 pCi/g. Table 6-7 presents the analytical results for the radiological isotopic samples, while Figure 6-15 shows the distribution of results across AOC 4.

6.3.1.2.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for residential soil, where applicable. As mentioned in Section 4.0, these PRGs were chosen for use because they represent the most recently updated human health screening values and in most instances are more conservative than the values published in the State of NJ standards. Full data presentations are located in Appendix F. Table 6-8 presents a summary of the metals constituents that exceed the PRG values, while Tables 6-9 and 6-10 present summaries of VOC/SVOC and PAH/PCB compounds, respectively. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-1-2 through B-1-6 (Surface Soil) and Tables B-2-2 through B-2-7 (All Depth Soil) presents these results.

Metals

Thallium was not detected in any of the 20 soil samples. Three metals (beryllium, cadmium and silver) were detected in only two samples each, while antimony, selenium, sodium were detected in three samples, six samples, and 11 samples, respectively. The remaining metals were reported for over 75% of the samples. Six metals have concentrations that exceeded the respective PRG, as presented in Table 6-8 and discussed below.

The single exceedance (36 mg/kg) of the PRG for antimony was reported in sample 4-SB-40-BS-P-06. The PRG for antimony is 31.3 mg//kg. Mercury was also reported above the PRG of 6.11 mg/kg in the same sample (9.4 mg/kg). Arsenic was detected above the PRG of 0.39 mg/kg in 19 soil samples. Concentrations exceeding the PRG ranged from 1.4 mg/kg in sample 4-SB-31-BS-P-05 to 20 mg/kg in sample 4-SB-34-BS-P-07.

Chromium was detected above the PRG in eight samples and lead in seven samples. Chromium concentrations ranged from 31 mg/kg in 4-SB-39-BS-P-01 to 77 mg/kg in 4-SB-34-BS-P-07. Lead concentrations ranged from 480 mg/kg in 4-SB-37-SS-P-00 to 5,000 mg/kg in 4-SB-40-BS-P-06. The PRGs for these metals are 30.1 mg/kg and 400 mg/kg, respectively. Only one location contained metals collocated with uranium (arsenic and chromium in sample 4-SB-34-BS-P-07).

VOCS and SVOCs

VOC analytes were detected in two soil samples, with the greatest frequency in 4-SB-40-BS-P-06. VOC concentrations in this sample ranged from 4,200 µg/kg benzene (PRG of 656 µg/kg) to 1,600,000 µg/kg 1, 2 -dichlorobenzene (PRG of 279,000 µ g/kg). The maximum VOC concentration of 1,900,000 µg/kg 1,2-dichlorobenzene was detected in sample 4-SB-38-BS-P-02. One SVOC was reported above the respective PRG in one sample. Sample 4-SB-38-BS_P-02 contained hexahlorobenzene at 76,000 µg/kg, compared to the PRG of 304 µg/kg. It should be noted that several of the SVOC compounds, such as chrysene or benzo(a)anthracene, are also reported as PAHs (PAHs are a subset of SVOCs and analyzed by different methodologies)) and are presented in the PAH discussion below. Table 6-9 presents the data summary for those VOC and SVOC concentrations exceeding the respective PRG values.

PAHs and PCBs

PAH compounds were detected above the PRG in soil samples obtained from 10 locations. The greatest frequency was reported in samples from borehole 4-SB-32. Sample 4-SB-32-SS-P-00 and 4-SB-32-BS-P-01 had maximum PAH concentrations of 5,400 µg/kg benzo(a)anthracene and 25,000 µg/kg chrysene, respectively. The PRG values for these compounds are 148 µg/kg and 14,800 µg/kg. One PCB compund (Aroclor-1254 at 810 µg/kg) was reported above the PRG of 222 µg/kg in 4-SB-40-BS-P-06. Table 6-10 presents the data summary for those compound concentrations exceeding the respective PRG values. Again, only one location (Boring 4-SB-34) contained PAHs or PCBS collocated with uranium.

6.3.1.3 Groundwater AOC 4

Groundwater elevations have been measured in all AOC 4 wells for the past four quarters of sampling (quarters 4 through 7). Well MW-I17-MO1A was also measured during quarters 2 and 3. Water level data obtained from AOC 4 wells are presented in Table 6-11. Groundwater flow direction in the A aquifer has consistently been to the northwest towards the Delaware River. As previously discussed Quarter 5 (September 2006) was determined to be a representative sampling period for the quarterly monitoring program. Figure 6-16 shows the groundwater elevation contours for the A aquifer during this representative sampling period. The average groundwater gradient in the A aquifer during the quarterly sampling program has been approximately 1%. The flow direction in the B aquifer is towards the southeast, away from the river. Figure 6-17 presents the water elevation contours and measurements obtained from each of the two B aquifer wells during this same period. Water level measurement forms are provided in Appendix G-2, while groundwater elevation contour maps by quarter are presented in Appendix I.

Geochemistry of Groundwater in OU 3-AOC 4

Groundwater stabilization parameters were measured during the purging of the wells prior to each sampling event. These included pH, specific conductance, temperature, ORP, turbidity, and DO. In addition, groundwater was analyzed after purging for concentrations of ferrous iron, nitrite and sulfide which are indicators of redox condition. The presence of hydrogen peroxide was tested for onsite as an indicator for the presence of uranium peroxide dihydrate. Water quality data representing stabilized conditions are presented in Table 6-12, while results for the

additional sampling parameters are provided in Table 6-13. Appendix L provides figures showing concentration trends in water quality data by quarter, as well as isopleth maps. The field results are described below. Calibration logs for the YSI meters used in .the field analysis are presented in Appendix K.

Five of the six A aquifer wells were stabilized to a final turbidity of 10 NTU or less (the target level for sampling) during quarters 4 and 5 sampling. All wells exhibited higher turbidity levels during the quarter 6 and 7 sampling, and were considered stabilized when three consecutive NTU readings were within ±10%. Piezometer I17-P01A consistently exhibited the highest levels of turbidity, ranging from 87 NTUs (quarter 5) to 828 NTUs (quarter 6). This well was purged dry during the quarter 7 field effort, and thus was not sampled. The B aquifer wells were also stabilized to less than 10 NTUs in the quarter 4 and 5 sampling, and stabilized to ±10% during quarters 6 and 7.

With a few exceptions, dissolved oxygen concentrations in the stabilized A Aquifer samples were less than one mg/L in all wells (80% of all samples), indicating a reducing environment. Samples obtained from 4-MW-02A and 4-MW-06A during the quarter 6 monitoring reported DO values in excess of the upper limit (9.1 mg/L); DO concentrations in both wells returned to less than one mg/L in the subsequent sampling. Well I17-P01A also had one of three samples exceed one mg/L (quarter 5). The average DO concentrations for all A Aquifer wells, with the exception of well I17-P01A (3.3 mg/L), were less than 1.5 mg/L; while the average concentration across the A aquifer was 0.88 mg/L. Results from the B Aquifer well 4-MW-01B, were also indicative of reducing conditions with an average DO concentration of 0.36 mg/L. Average values for the remaining B aquifer well could not be determined. ORP values were strongly reducing in both A Aquifer wells and the B Aquifer wells, with average values ranging from -74.06 mV to -179.94 mV. The average ORP reading over time in the A aquifer was -118.58 mV, while the average among the two B Aquifer wells was -93.26 mV. The average DO and ORP values for AOC 4 wells are presented in Figure 6-18.

Specific conductance values in the A aquifer wells ranged from an average of 594 µS/cm to 2,840 µS/cm, with an average value of 1,893 µS/cm across the aquifer Values for the B aquifer wells ranged from 1,715 µS/cm to 2,553 µS/cm, with an average aquifer value of 1,939 µS/cm.

Average values for pH were circum-neutral, ranging from 6.82 to 7.65. The average pH value over time for the A Aquifer was 7.08; while the B Aquifer wells were slightly acidic (average of 6.74).

Ferrous iron concentrations ranged from an average of 1.24 mg/L to 3.30 mg/L in the A Aquifer wells, while average concentrations in the B Aquifer ranged from 2.55 mg/L to 3.29 mg/L. Nitrite was detected once in each of three wells in the A Aquifer and one in the B aquifer, with concentrations less than one mg/L. Values for both ferrous iron and nitrite support a reducing environment.

The sulfide concentrations in both aquifers were low, averaging from 0.01 mg/L to 0.22 mg/L in the A aquifer wells and 0.03 mg/L in the B aquifer. Hydrogen peroxide was detected sporadically in the AOC 4 wells, and was reported in a total 10 of 32 samples, with concentrations ranging from 0.05 mg/L to 4.80 mg/L. The maximum concentration was detected during the quarter 4 sampling in well 4-I17-MO1A. Overall, the average hydrogen peroxide values ranged from 0.07 mg/L to 1.18 mg/L.

Major Ions in Groundwater

Concentrations of major cations and anions were analyzed to interpret their effect on uranium geochemistry. Concentrations of the inorganic ions chloride, fluoride, sulfate, phosphate (as phosphorous), nitrate/nitrite, and alkalinity were measured. Sample results for major cations and anions obtained for AOC 4 are presented in Table 6-14.

Average alkalinity values are indicative of 'hard' to 'very hard' water quality. Values in the A Aquifer ranged from 140 mg/L to 1,400 mg/L (average of 488 mg/L), and from 410 mg/L to 990 mg/L (average of 761.5 mg/L) in the B aquifer. Average chloride concentrations ranged from 10 mg/L to 410 mg/L in the A Aquifer, while concentrations in the B aquifer ranged from 183 mg/L to 283 mg/L. For comparative purposes, the NJDEP WQC for chloride is 250 mg/L.

Sulfate values were considerably higher in the A aquifer (15 mg/L to 1,600 mg/L) than in the B aquifer (15 mg/L to 57 mg/L). Sulfate values in wells I17-MO1A and 4-MW-06 were

consistently higher than other A Aquifer wells by one or two orders of magnitude. The NJDEP WQC for sulfate is also 250 mg/L.

Average fluoride values in the Aquifer were between 1.5 and 6.9 mg/L. Fluoride was detected in one of the two B Aquifer wells, (4-MW-01), with an average value of 0.57 mg/L. Nitrite/nitrate values were low, with averages less than one mg/L in both aquifers. Total phosphorus concentrations were slightly higher in the B aquifer (0.81 to 1.5 mg/L) than in the A aquifer (0.075 to 0.62 mg/L).

6.3.1.3.1 Radiological Constituents

Uranium

All eight AOC 4 monitoring wells were sampled for isotopic and total uranium in Quarters 4 through 7 (6/2006, 9/2006, 2/2007 and 5/2007). Well I17-M01A was also sampled in Quarter 3 (11/2005). A total of 32 groundwater samples were collected from AOC 4 (24 samples from the A aquifer and eight samples from the B aquifer). Comprehensive sample results for isotopic and total uranium in the AOC 4 wells are presented in Table 6-15. Total uranium results exceeding the MCL of 30 µg/L have been highlighted. These exceedances have been utilized to determine the extent of groundwater contamination, and are the focus of the discussions presented below. As discussed in previous sections, the uranium results reported by the laboratory as pCi/L have been converted to mass units of µg/L by dividing the result by a factor of 0.667 to allow comparison to the MCL. Average isotopic and total uranium results for A Aquifer wells are presented in Figure 6-19, while concentration trends for total uranium are found in Figure 6-20. A total uranium isopleth map representing average concentrations in the A aquifer over time is shown in Figure 6-21.

Average isotopic and total uranium results for B aquifer wells are presented in Figure 6-22, while concentration trends for total uranium are found in Figure 6-23.

Groundwater laboratory data for both primary and QA analyses are presented in Appendix H. The QA/QC evaluation results are presented in Appendix M.

Well I17-M01A contained total uranium concentrations exceeding the MCL of 30 µg/L. As previously discussed, this well is located within the uranium-impacted area as identified through

the expedited characterization effort. The well is also located adjacent to soil boring 4-SB-24, which contained potentially contaminated soils. Uranium concentrations in well I17-M01A ranged from a maximum of 200 µg/L (Quarter 3) to 50 µg/L (Quarter 7) and have averaged 145 µg/L. While analytical data collected over six quarters of sampling indicate that concentrations of uranium in this well appear to be declining over time, concentrations still exceed the MCL of 30 µg/L. The initial sample (4-MW-06-GU-P-02, Quarter 4) for Well 4-MW-06A slightly exceeded the MCL with a value of 31.9 µg/L. Subsequent sample concentrations were below the MCL, and the average uranium concentration for well 4-MW-06A was 22 µg/L. All other A Aquifer wells had uranium concentrations below the MCL.

Uranium contamination is bounded in the A aquifer by well I17-P01A (upgradient control) and wells 4-MW-02A and 4-MW-07A (downgradient control) It should be noted that uranium levels in 4-MW-02A appear to be increasing slightly over time, however, both the maximum value detected to date (sample 4-MW-02-GU-P-02, quarter 7; 15 µg/L) and the average concentration for this well (11.4 pCi/L) are below the MCL. Cross-gradient control is provided by wells 4-MW-05A and 4-MW-06A.

Total uranium was detected sporadically and at low levels in the B aquifer wells. The two detections of total uranium were also reported in well 4-MW-07B, and were less than one pCi/L.

Other Radionuclides

In addition to radiochemical analysis for uranium described above, groundwater samples from all quarters (32 samples) were analyzed for the radiochemical parameters gross alpha / gross beta, Ra-226 and Ra-228. The thorium isotopes Th-228, Th-230 and Th-232 were analyzed beginning in Quarter 4; resulting in a total of 30 samples (well I17-M01A did not have thorium isotope data for Quarters 2 and 3). Comprehensive radionuclide results are found in Table 6-16. For those radionuclides with corresponding MCL values, the results exceeding the MCL have been highlighted. Results for the A aquifer wells are depicted in Figure 6-24 and in Figure 6-25 for the two B aquifer wells.

In the A Aquifer, gross alpha concentrations consistently exceeded the MCL of 15 pCi/L in well I17-MO1A. Concentrations in sample I17-MO1A-GU-P-02 ranged from a maximum of 92

pCi/L (quarter 4) to 40 pCi/L (quarter 7). The average gross alpha concentration for this well was 67.6 pCi/L. Groundwater from 4-MW-06A also exceeded the MCL during the quarter 4 sampling with a value of 28.9 pCi/L (sample 4-MW-06-GU-P-02). While subsequent sample results from 4-MW-06A have been below the MCL, the average gross alpha concentration for this well is 15 pCi/L (equal to the MCL). All of the above Gross Alpha exceedances are attributed to the presence of uranium in these samples.

Average gross beta concentrations ranged from 1.3 pCi/L to 71.8 pCi/L (well I17-M01A). Gross Beta exceedances are also attributable to the presence of uranium in this sample. No Ra-226 or Ra-228 concentrations exceeded the MCL for combined Ra-266/Ra-228 of 5 pCi/L. In general, average radium data was reported between 0.21 pCi/L and 1.30 pCi/L.

The thorium isotopes Th-228 (in the thorium decay series), Th-232 and Th-230 (in the uranium decay series) were detected infrequently in A Aquifer groundwater. Of the 22 samples analyzed for these isotopes, Th-228 was detected in four samples (0.18 pCi/L to 0.225 pCi/L); Th-230 in three samples (0.177 pCi/L to 0. 26 pCi/L); and Th-232 in five samples (0.015 pCi/L to 0.59 pCi/L).

In the B aquifer, gross alpha was not detected above the MCL of 15 pCi/L, with the highest average value of 2.85 pCi/L. Gross beta values were lower than those in the A aquifer, with averages of 9.3 pCi/L and 16.3 pCi/l. Average radium data was reported between 0.23 pCi/L and 0.93 pCi/L, and all combined radium data was less than the MCL of 5 pCi/L. No Th-228 was detected; and Th-230 and Th-232 were reported in one sample each at concentrations of 0.13 pCi/L and 0.02 pCi/L, respectively

6.3.1.3.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for tap water. Full data presentations are presented in Appendix H. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-3-2 and B-3-6 presents these results.

Metals

Six metals were detected in 100% of the samples, while eight were not found in any samples. Three (antimony, arsenic and zinc) were detected in less than five samples; while aluminum, chromium, mercury and vanadium were detected in only one sample each. The remaining metals were detected in 55% to 65% of the samples. Six metals had concentrations exceeding the PRG, as discussed below. Table 6-17 presents the data summary for those metals concentrations exceeding the respective PRG value.

In the A aquifer, antimony was reported above the PRG of 0.0146 mg/L in three wells. The highest concentrations were detected in sample 4-MW-06-GU-P-02. A maximum concentration of 0.83 mg/L was reported during the Quarter 3 sampling event; while the most recent sampling for Quarter 6 indicated a maximum level of 0.034 mg/L. Well I17-PO1A contained arsenic and chromium above the PRGs of 0.0000448 mg/L and 0.11 mg/L, respectively. Results from the Quarters 3 and 4 sampling indicate maximum concentrations of these constituents at 0.031 mg/L arsenic and 0.18 mg/L chromium.

Sample 4-MW-06-GU-P-02 contained elevated levels of lead in the earlier sampling events (Quarter 3 (0.03 mg/L) and Quarter 4 (0.24mg/L); while more recent sampling indicates concentrations below the PRG of 0.015 mg/L. Lead also exceeded the PRG in sample I17-PO1A-GU-P-02 (0.32 mg/L in Quarter 5). Concentrations of manganese exceeded the PRG of 1.70 mg/L in three A aquifer wells, with the maximum concentration of 2.7 mg/L detected in sample I17-M01A-GU-P-02 (Quarter 3).

In the B aquifer, manganese consistently exceeded the PRG in Well 4-MW-07. Samples from this well indicate concentrations between 2.4 and 3.5 mg/L. Arsenic also exceeded the PRG in two wells at concentrations slightly above the detection limit.

VOCs and SVOCs

A total of eight groundwater samples were analyzed for VOCs; with six samples indicating concentrations above the PRGs. Four of the six samples are from wells located in the A aquifer. Samples from A aquifer wells 4-MW-06 and I17-M01A contained the greatest frequency of compounds above the PRGs; while sample 4-MW-06-GU-P-02 contained the maximum reported

concentrations. VOC levels in this sample ranged from 210 µg/L 1,2-trichlorobenzene to 10,000 µg/L 1,2-dichlorobenzene. The PRGs for these compounds are 8.16 µg/L and 49.3 µg/L, respectively. B aquifer well H17-MO2B contained concentrations of VOCs ranging from 120 µg/L naphthalene (PRG of 6.2 µg/L) to 5,800 µg/L benzene (PRG of 0.354 µg/L).

SVOCs were detected above the PRGs in five A aquifer wells and one B aquifer well, with the highest frequency of compounds detected in wells 4-MW-06; H17-MO2B and I17-MO1A. The maximum concentrations were reported in sample H17-M02B-GU-P-02, with 49,000 µg/L 4-chloroaniline and 170,000 µg/L aniline. The PRGs for these compounds are 146 µg/L and 11.8 µg/L, respectively. No SVOCs were detected above the PRGs in the B aquifer.

Table 6-18 presents the data summary for those compound concentrations exceeding the respective PRG value.

6.3.1.4 Surface Water and Sediments, AOC 4

No surface water features are present at AOC 4; therefore, no surface water or sediment samples were collected at this AOC during the RI.

6.3.2 AOC 6, East Area

6.3.2.1 Source Zones

The primary source of potential contamination in OU 3, AOC 6 is believed to be in the form of contaminated rubble, equipment and materials that were disposed after the demolition of MED buildings in OU 1.

6.3.2.2 Soils and Vadose Zone, AOC 6

Soil samples were obtained from a total of 49 soil borings in AOC 6. Ninety-one soil samples plus duplicates and third-party splits were collected from these borings. All soil samples were analyzed for total uranium (71 by gamma spectroscopy and 20 by alpha spectroscopy), Th-234, U-235, and Ra-226 (all gamma spectroscopy analysis), while 29 samples were analyzed Th-230 (alpha spectroscopy). Twenty samples were analyzed for isotopic uranium (U-234, U-235 and U-238) via alpha spectroscopy. All 91 samples were analyzed for U-235 by gamma spectroscopy.

Chemical constituents (TAL metals, VOCs/SVOCs and PAHs/PCBs)) were also analyzed in a subset of 20 soil samples from AOC 6 in support of the BRA.

6.3.2.2.1 Radiological Constituents

Uranium

As previously discussed, characterization results for total uranium were compared to the ISV of 14 pCi/g in order to define the extent of potential soil contamination. Analytical results for total uranium from both the offsite laboratory alpha and gamma spectroscopy analyses are presented in Table 6-21. The maximum concentration reported for any sample (alpha or gamma spectroscopy) is presented in the text and depicted on associated figures. A brief summary of the isotopic U and Th-234 results is also provided in this section, while the analytical results are presented along with analytical data results for the other eligible radiological contaminants Ra-226 and Th-230.

Fifty-four of the Th-234 samples were non-detect (60%), while reported concentrations ranged from 1.8 to 1,910 pCi/g. Samples for U-234 ranged from 0.55 pCi/g to 1,770 pCi/g. U-235 alpha spectroscopy samples were between 0.04 pCi/g and 105 pCi/g, while 69% (63 of the 91 samples) were reported as non-detects for the U-235 gamma spectroscopy samples with detected concentrations between 0.82 pCi/g and 97 pCi/g. Concentrations of U-238 ranged from 0.65 pCi/g to 1,830 pCi/g. The maximum concentrations of these isotopes were reported in two of the same sample locations for which uranium contamination was detected (6-SB-04 for Th-234 and 6-SB-38 for the others), as discussed below.

Horizontal Extent

In AOC 6, the GWS encompassed the majority of what was once the East Burial Area (AOI 4). A total of 10.8 acres was surveyed in this AOC. Because of elevated surface gamma activity, a higher density of soil borings was concentrated along East Road. Areas at higher ground surface elevations than East Road, specifically the Firefighter Training Area (AOI 6) to the north, were omitted due to the thickness of cover that has been filled in over the years in the area. Gamma walkover surveys conducted in similar areas on East Road resulted in gamma readings of approximately half the observed values along East Road. Of the 74,916 data points collected, 74,546 data points exhibited Z-Scores below the action level of three. Of the remaining data

points, 64 was the highest Z-Score, which corresponded to a count rate of 104,283 cpm. The mean count rate for all of AOC 6 was calculated to be 4,927 cpm, with a standard deviation of 1,555 cpm. A Z-Score of three encloses 99.73% of a normal population, therefore the portion of a normal population expected to exceed the upper limit confidence interval is calculated as [(100%-99.73%)/2] or 0.135%. In other words, of the 74,916 data points collected, 0.135% or 101 data points would be expected to exceed the Z-Score of three. The observed number of exceeding data points was 370, therefore 269 data points or 0.36% exceeded a normal distribution.

A graphic representation of the AOC 6 GWS is presented in Figure 6-26. As depicted in the figure, the regions of highest surface gamma activity were located in the vicinity of East Road (6CPT62, 6CPT63, and 6CPT64). These areas were investigated during the subsequent soil boring activities to discern the source of the high gamma measurements.

Vertical Extent

During gamma logging activities, two locations (6CPT21, 6CPT37, Figure 6-8) exhibited elevated uranium, one (6CPT05) exhibited elevated K-40, and three (6CPT25, 6CPT45, 6CPT54) did not exhibit any elevated radioactivity. These six locations were selected for confirmation soil sampling during the CPT investigation. Tables 6-19 and 6-20 show the gross gamma results for the AOC 6 core samples. All measurements were collected as average integrated one minute count rates. Field results from AOI 6 are similar to results from the Lagoon Area in that gross gamma results generally ranged from 4500 to 6500 cpm, and were highest in the (native) clay intervals. However, locations SB-19 and SB-20 exhibited maximum gross gamma activities in the 7000 to 8000 cpm range at a depth of approximately seven ft, within fill and rubble. Clay content was not high in this interval, but the occurrence of cinders was noted.

Field results from AOI 4 (East Burial Area) showed elevated gross gamma activities of up to 100,000 cpm. A continuous native clay layer was not evident in this area.

A total of 91 soil samples (including the CPT samples discussed above) were collected from 49 borings in AOC 6, of which 45 (or 49%) were reported as ND for total uranium, with reporting

limits ranging from 0.03 to 7.1 pCi/g. Twenty-eight samples contained total uranium concentrations that exceeded the ISV of 14 pCi/g. Uranium data has been evaluated against the ISV to determine the extent of potential contamination.

Eighteen boring locations in AOC 6-AOI 4 exhibited elevated uranium concentrations at depths less than four ft bgs as presented on Figure 6-29. The highest concentration of total uranium measured in this area was from boring 6-SB-04 (3,910 pCi/g in sample 6-SB-04-B-P-01). The next two highest sample concentrations were detected in borings 6-SB-38 (adjacent to 6-SB-04) and 6CPT-62A (in the ditch area, north of East Road). Total uranium of 3,740 pCi/g was reported in sample 6-SB-38-SS-P-01 (zero to one foot); while a concentration of 1,280 pCi/g was reported in sample 6CPT-62A-B-P-0.5 (first six inches of soil). The remaining sample exceedances of the ISV ranged from 15.7 pCi/g (6-SB-08-B-P-02 at 2.5 ft bgs) to 3,740 pCi/g (6-SB-38-SS-P-01, zero to one foot bgs). Most potentially contaminated soils were detected at discrete intervals within each boring; only two borings (6-SB-37 and 6-SB-38) were potentially contaminated between the surface and two ft bgs depth.

Results from samples obtained from boring 6CPT21 (which had been selected for confirmation sampling due to the presence of elevated uranium during gamma logging) indicated a total uranium concentration of 69 pCi/g in the two to three ft depth. The remaining CPT confirmation samples were reported as NDs for the shallower soils.

Four locations in AOI 6 exhibited deeper soil contamination at discrete depth intervals between six and 12 ft bgs. Uranium concentrations in these locations ranged from 37.3 pCi/g (sample 6-SB-19-B-P-11, 12 ft bgs) to 153 pCi/g (sample 6CPT-37-B-P-08, 8.5 ft bgs). Location 6CPT37 has also been identified as a confirmation sample location during gamma logging. Boring 6-SB-19 also contained uranium at a concentration of 71.3 pCi/g in the six to seven ft depth. Samples 6-SB-22-B-P-10 and 6-SB-20-B-P-07 contained uranium at concentrations of 72 pCi/g (11 ft bgs depth and 101 pCi/g (seven ft bgs depth), respectively. Elevated gross gamma activity had been noted at the seven ft depth for locations 6-SB-19 and 6-SB-20 during logging.

Table 6-21 presents the analytical results with ISV exceedances shaded. Figure 6-27 shows the distribution of uranium results across the entire AOC. Figure 6-28 presents a cross sectional view of the vertical extent of uranium contamination about the ISV across AOC 6.

Other Radiological Constituents

The maximum concentrations of the other radiological constituents analyzed in AOC 6 soil borings were collocated in two of the same sample locations for which the highest uranium contamination was detected. Sample 6-SB-38-SS-P-00 contained the maximum concentrations of Th-230 (69 pCi/g and the second highest concentration of Ra-226 (9.8 pCi/g). Total uranium in this sample was 3,740 pCi/g. Sample 6-SB-04-B-P-01 contained the maximum Ra-226 concentration of 14.3pCi/g (total uranium was 3,910 pCi/g). Both locations are within AOI 4.

Table 6-22 presents the analytical results for the radiological isotopic samples, while Figure 6-29 shows the distribution of results across AOC 6.

6.3.2.2.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for residential soil, where applicable. Table 6-23 presents a summary of the metals constituents that exceed the PRG values, while Tables 6-24 and 6-25 present summaries of VOC/SVOC and PAH/PCB compounds, respectively. Full data presentations are located in Appendix F. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b).

Metals

Thallium and silver were not detected in any of the 20 samples. Three metals (antimony, beryllium and cadmium) were detected in only two or three samples while two (mercury and selenium) were detected in less than eight samples. The remaining 16 metals were detected in more than 85% of the 20 soil samples. Six metals have concentrations that exceeded the respective PRG, as presented in Table 6-23 and discussed below.

The maximum of the two antimony exceedances (280 mg/kg), along with the single cadmium, chromium and iron exceedances, were reported in sample 6-SB-40-BS-P-05. Antimony was also

detected above the PRG of 31.3 mg/kg in sample 6-SB-41-BS-P-05. Mercury was reported above the PRG of 6.11 mg/kg in sample 6-SB-41-SS-P-00 (11 mg/kg). Arsenic was detected above the PRG of 0.39 mg/kg in 19 of the 20 samples, with concentrations ranging from 1.2 mg/kg (6-SB-34-BS-P-03) to 11 mg/kg in 6-SB-40-BS-P-05. Arsenic was collocated with uranium in five of 10 borings (6-SB34 through 38) in AOI 1.

VOCs and SVOCs

VOCs were detected in two of 20 soil samples, with naphthalene values of 270,000 µg/kg and 560,000 µg/kg in 6-SB-40-BS-P-05 and 6-SB-41-BS-P-05, respectively. The PRG for naphthalene is 125,000 µg/kg. SVOCs were reported above the PRGs in sample 6-SB-40-BS-P-05 (5,000 µg/kg azobenzene compared to a PRG of 4,420 µg/. Table 6-24 presents the data summary for those compound concentrations exceeding the respective PRG value.

PAHs and PCBs

PAH compounds were detected above the PRGs in nine soil samples, with the greatest frequency reported in samples from boreholes 6-SB-40 and 6-SB-41 Samples from 6-SB-41 contained the maximum PAH concentrations, ranging from 3,800 µg/kg dibenzo(a,h)anthracene to 3,700,000 µg/kg fluorene in 6-SS-41-P-00 and 4,700 µg/kg dibenzo(a,h)anthracene to 10,000,00 µg/kg fluorene in 6-SB-41-BS-P-05. The PRG values for these compounds are 14.8 µg/kg and 2,644,000 µg/kg, respectively. No PCB compounds were detected in AOC 6 soils at concentrations exceeding a respective PRG value. Table 6-25 presents the data summary for those compound concentrations exceeding the respective PRG value.

6.3.2.3 Groundwater

Groundwater Flow Parameters in OU 3 - AOC 6

Groundwater elevations have been measured in all seven of the AOC 6 B aquifer wells for the past four quarters of sampling (quarters 4 through 7). Three wells existed previous to quarter 4 and therefore, elevations were obtained from these wells during the third quarter. Water level data obtained from the AOC 6 wells are presented in Table 6-26. Groundwater flow direction has consistently been towards the southwest. Groundwater elevation contours from Quarter 5 (September 2006) are representative of the quarterly sampling monitoring program and are presented in Figure 6-30. The average groundwater gradient in the B Aquifer during the

quarterly sampling program has been 0.4%. Water level measurement forms are provided in Appendix G-2, while groundwater elevation contour figures by quarter are included in Appendix I.

Geochemistry of AOC 6 Groundwater

Groundwater stabilization parameters were measured during the purging of the wells prior to each sampling event. This included pH, specific conductance, temperature, ORP, turbidity and DO. In addition, groundwater was analyzed at the time of purging for concentrations of ferrous iron, nitrite and sulfide (which may be considered indicators of biodegradation activity), as well as for the presence of hydrogen peroxide. Groundwater quality data representing stabilized conditions are presented in Table 6-27, while results for the additional sampling parameters are provided in Table 6-28. Appendix L provides figures showing concentration trends in water quality data by quarter, as well as isopleth maps. The field results are described below. Calibration logs for the YSI meters used in the field analysis are presented in Appendix K.

All wells except 6-MW-02B were stabilized to a final turbidity of 10 NTUs or less in the quarter 3 through 5 sampling. An NTU of 77 mg/L was reported in Well 6-MW-02B during quarter 3. Readings in this well were below 10 NTU for all remaining sampling. The wells exhibited higher turbidity levels in the quarter 6 (and in some cases, the quarter 7) sampling, and were considered stabilized when three consecutive NTU readings were within ±10%.

Dissolved oxygen concentrations were less than one mg/L in 21 of 31 total groundwater samples (68%), indicating a reducing environment. Average sample values ranged from 0.48 mg/L to 2.5 mg/L. The average DO concentration for the B aquifer over time was 1.2 mg/L. In general, ORP values for AOC 6 were positive, with an average value for the B aquifer of 82 mV. Only the deep well 6-MW-07B consistently indicated reducing conditions during all sampling, with ORP values between -52 mV and -101 mV. The average ORP for this well was -82 mV. While values in down-gradient well 6-MW-05B ranged from -97 mV to 37 mV, the average ORP value of -29 mV is also indicative of reducing conditions. Figure 6-31 presents the average DO and ORP values for the AOC 6 wells.

Average specific conductance values ranged from 423 µS/cm to 2,078 µS/cm, with an average aquifer value of 1,189 µS/cm. Average pH values ranged from 5.8 (slightly acidic) to 8.5 (slightly basic). One sample from well 6-MW-07B taken during quarter 5 was highly basic, with a value of 11.83. The average pH value for the B aquifer was 6.4.

Ferrous iron concentrations ranged from an average of 0.26 mg/L to 2.9 mg/L, while nitrite was detected at values less than one mg/L in five wells, and was not detected in any samples from 6-MW-04B and 6-MW-07B. Concentrations of both parameters support the presence of reducing conditions in the B aquifer.

The average sulfide concentrations were between 0.01 mg/L to 0.04 mg/L. Hydrogen peroxide was detected in approximately 50% of the AOC 6 groundwater samples, with average concentrations ranging from 0.12 mg/L to 1.04 mg/L. No hydrogen peroxide was detected in any samples from well 6-MW-04B and in only one sample each from wells 6-MW-05B and 6-MW-07B (quarter 7 sampling).

Major Ions in Groundwater

Concentrations of major cations and anions were analyzed to interpret their effect on uranium geochemistry. Concentrations of the inorganic ions chloride, fluoride, sulfate, phosphate (as phosphorous), nitrate/nitrite, and alkalinity were measured as well as the metals calcium, magnesium, sodium, and potassium. Sample results for major cations and anions obtained for AOC 6 are presented in Table 6-29.

The average alkalinity value for the B aquifer in AOC 6 is indicative of 'hard' to 'very hard' water quality (140 mg/L.) Three wells exhibit high alkalinity: 6-MW-01B (180 mg/L; 6-MW-04B (160 mg/L); and 6-MW-06B (320 mg/L). The remaining wells would be categorized as 'slightly to moderately hard' with values ranging from 34 mg/L to 90 mg/L.

Average chloride concentrations ranged from 7.1 mg/L to 580 mg/L across the B aquifer, with the highest concentrations detected in wells 6-MW-03B (428 mg/L) and 6-MW-04B (558 mg/L). For comparative purposes, the NJDEP WQC for chloride is 250 mg/L. Sulfate also exhibited a wide range of values (68 mg/L to 923 mg/L). The highest average concentrations were detected

in the wells with the lowest chloride values (6-MW-06 and 6-MW-07). The NJDEP WQC for sulfate is also 250 mg/L.

Fluoride, nitrate/nitrite and total phosphorus values were low, and averaged less than one mg/L each. Phosphorous was not detected in any samples from well 6-MW-03B and in just one sample from well 6-MW-02B.

6.3.2.3.1 Radiological Constituents

Uranium

All seven AOC 6 B aquifer monitoring wells were sampled for isotopic and total uranium in Quarters 4 through 7 (6/2006, 9/2006, 2/2007 and 5/2007). Three wells (6-MW-01B, 6-MW-02B and 6-MW-03B) were also sampled in Quarter 3 (11/2005). A total of 31 groundwater samples were collected. Comprehensive sample results for both isotopic and total uranium in the AOC 6 wells are presented in Table 6-30. Total uranium results exceeding the MCL of 30 µg/L have been highlighted. These exceedances have been utilized to determine the extent of groundwater contamination, and are the focus of the discussions presented below. As discussed in previous sections, the uranium results reported by the laboratory as pCi/L have been converted to mass units of µg/L by dividing the result by a factor of 0.667 to allow comparison to the MCL. Figure 6-32 presents the results for the isotopic and total uranium in AOC 6 wells, while concentration trends for total uranium are found in Figure 6-33. An average total uranium isopleth is presented for AOC 6 in Figure 6-34.

Groundwater laboratory data for both primary and QA analyses are presented in Appendix H. The QA/QC evaluation results are presented in Appendix M

Well 6-MW-01B exhibited total uranium concentrations exceeding the MCL of 30 µg/L. As previously discussed, the initial uranium sample result for this well (6-MW-01-GU-P-02, quarter 3) was 763 µg/L. Subsequent analytical results reported concentrations between 187 µg/L (quarter 4) and 106 µg/L (quarter 7). The average uranium concentration for this well was 267 µg/L. While no soil borings in this general area contained elevated uranium, the well is located downgradient of an area of potentially contaminated soils, and thus may contain dissolved uranium in soil particulates which have migrated along the groundwater flow path. The

remaining wells in AOC 6 (6-MW-02B through 6-MW-07B) had uranium concentrations below the MCL, and all average values were below five pCi/L. It should be noted that while 6-MW-07B is located adjacent to 6-MW-01B, well 6-MW-07B was completed to the base of the B Aquifer (50 ft bgs) in order to provide vertical delineation of potential groundwater contamination. In contrast, 6-MW-01B is completed to a depth of 17 ft bgs.

Other Radionuclides

In addition to radiochemical analysis for uranium described above, groundwater samples from all quarters (31 samples) were analyzed for the radiochemical parameters gross alpha / gross beta, Ra-226 and Ra-228. The thorium isotopes Th-228, Th-230 and Th-232 were analyzed beginning in Quarter 4, resulting in a total of 28 samples (wells 6-MW-01B through 6-MW-03B did not have thorium isotope data for quarter 3). Comprehensive radionuclide results are presented in Table 6-31. For those radionuclides with corresponding MCL values, the results exceeding the MCL have been highlighted. Figure 6-35 presents average results for AOC 6 wells.

The MCL for gross alpha (15 pCi/L) was consistently exceeded in well 6-MW-01B. The average gross alpha concentration at this location was 119 pCi/L, and individual concentrations ranged from a maximum of 317 pCi/L (quarter 4) to 31.2 pCi/L (quarter 7). Data from all other AOC 6 wells indicated that concentrations were below the gross alpha MCL. Gross beta concentrations averaged between 5.1 pCi/L and 58.5 pCi/L with the highest reported value also in 6-MW-01. All of the above gross alpha exceedances, as well as gross beta concentrations, are attributed to the presence of uranium.

No Ra-226 or Ra-228 concentrations exceeded the MCL for combined Ra-226/Ra-228 of five pCi/L. Average reported values for Ra-226, and Ra-228 were between 0.12 pCi/L and 1.03 pCi/L. No Th-228 was detected in any B aquifer samples, while Th-230 was detected in only two of the 28 samples (0.133 pCi/L to 0.171 pCi/L) and Th-232 in five samples (0.018 pCi/L to 0.026 pCi/L).

6.3.2.3.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those constituents for which concentrations have exceeded the USEPA Region 6 PRGs for tap water. Full data presentations

are presented in Appendix H-2. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-3-2, B-3-3, and B-3-4 present these results.

Metals

Six metals were detected in more than 90% of the 29 groundwater samples. Eight metals were not found in any samples. Chromium and selenium were detected in three samples; copper in four; while lead was detected in a total of seven samples. The remaining metals were detected in 25% to 50% of the samples. Four metals had concentrations exceeding the PRGs.

Arsenic was reported in concentrations exceeding the PRG of 0.0004 mg/L in three of the seven B aquifer wells. The maximum concentrations were detected in sample 6-MW-04-GU-P-02, ranging from 0.011 mg/L to 0.021 mg/L over four quarters of sampling. Iron was also reported above the PRG in this sample. Lead was detected above the PRG of 0.015 mg/L in the most recent sample round (Quarter 6) in 6-MW-01-GU-P-02 (0.077 mg/L), while manganese was detected above the PRG of 1.70 mg/L in three quarters of sampling for Well 6-MW-03. Sample concentrations ranged from 2.1 mg/L to 2.3 mg/L. Table 6-32 presents the data summary for those metal concentrations exceeding the respective PRG value.

VOCs and SVOCs

VOCs and SVOCs were detected above the PRGs in all seven B aquifer wells. The maximum concentrations were reported in sample 6-MW-01-GU-P-02, ranging from 820 µg/L 1,4-dichlorobenzene to 32,000 µg/L 1,2-dichlorobenzene. The PRG values for these compounds are 0.467 µg/L and 49.3 µg/L, respectively. Table 6-33 presents the data summary for those compound concentrations exceeding the respective PRG value.

6.3.2.4 Surface Water and Sediment Results, AOC 6

6.3.2.4.1 Radiological Constituents

Comprehensive sample results for isotopic and total uranium for the surface water samples obtained in AOC 6 are presented in Table 6-34. Similar to the groundwater data presentations, those total uranium concentrations exceeding the MCL of 30 µg/L have been highlighted, and are the focus of the discussion on nature and extent of contamination. Sediment results are

provided in Table 6-35, with the total uranium concentrations exceeding the ISV of 14 pCi/g highlighted. Results for other radiochemical constituents are provided in Tables 6-36 (surface water) and 6-37 (sediment). Sample results for sediment in AOC 6 are presented in Figure 6-37. Laboratory data for both primary and QA analysis (surface water and sediment) are presented in Appendix P.

Total Uranium

Of the 12 surface water samples, the only exceedance of the total uranium MCL was detected in sample 6-SW-02-S-P-01, with a concentration was 265 µg/L. MED related uranium occurs near the ground surface on the northern bank of the ditch near where this sample was collected. As the sample was obtained during a storm event, it most likely was turbid and contained surface soil particulates from the bank. As demonstrated by the sediment results, any potentially contaminated soils washed into the ditch have not migrated. Concentrations of total uranium values for the remaining 11 samples were reported at less than three µg/L

Of the 13 sediment samples, only sample 6-SD-11-P-00 (18.4 pCi/g) exceeded the ISV of 14 pCi/g. Uranium concentrations in the remaining sediment samples ranged from 0.7 to 13 pCi/g.

Other Radiological

In addition to radiochemical analysis for uranium described above, all 12 surface water samples were analyzed for the radiochemical parameters gross alpha / gross beta, Ra-226/Ra-228 and thorium isotopes Th-228, Th-230 and Th-232. All sediment samples were analyzed for Ra-226 and the thorium isotopes. Comprehensive radionuclide results for surface water are presented in Table 6-36. For those radionuclides with corresponding MCL values, the results exceeding the MCL have been highlighted. Radionuclide results for sediment are presented in Table 6-37.

The MCL for gross alpha (15 pCi/L) was exceeded in sample 6-SW-02-S-P-01. The gross alpha concentration for this sample was 89 pCi/L. Gross alpha concentrations for the remaining 11 surface water samples were less than five pCi/L. The maximum gross beta concentration (83 pCi/L) was also reported in sample 6-SW-02-S-P-01. With the exception of this sample, gross beta concentrations ranged from 4.9 pCi/L to 10.3 pCi/L. The presence of the gross alpha and

gross beta in surface water is attributable to the presence of uranium. Total uranium was reported in this sample at 265 µg/L.

Radium-226 was detected in one sample (0.17 pCi/L, sample 6-SW-09-SW-P-00), while Ra-228 was not detected in any surface water sample in AOC 6. No Th-228 or Th-230 was detected; one Th-232 value was reported for sample 6-SW-02-S-P-01 (0.015 pCi/L).

The maximum concentrations of Ra-226 (1.6 pCi/g), Th-230 (1.04 pCi/g) and Th-232 (9.7 pCi/g) were detected in sample 6-SD-11-P-00 (total uranium of 18.4 pCi/g). Th-234 was detected at 6.3 pCi/g in sample 6-SD-02-D-P-001.

6.3.2.4.2 Chemical Constituents

The data summary discussions presented in this subsection focus on those surface water and sediment constituents for which concentrations have exceeded the USEPA Region 6 PRG for tap water or residential soil, respectively. Full data presentations are presented in Appendix P. In addition, for a comparison of these analytical results for chemical constituents to site background concentrations the reader is referred to the background screening step of the BRA (CABRERA 2011b). Appendix B of the BRA, Tables B-4-2 through B-4-4 present the surface water results and Tables B-5-2 through B-5-6 present the results for sediment.

Metals

Lead was the only metal in surface water to exceed a respective PRG. Concentrations ranged from 16 µg/L (6-SW-04-SW-P-00) to 230 µg/L (6-SW-12-SW-P-00) compared to a PRG of 15 µg/L. Table 6-38 presents the data summary for those surface water metals concentrations exceeding the respective PRG value.

Only two metals exceeded the PRG in AOC 6 sediments. Arsenic was reported above the PRG in eight of the 10 samples, while chromium exceeded the PRG in one sample. The maximum arsenic concentration (18 mg/kg) and the chromium exceedance (66 mg/kg) were both observed in 6-SD-11-SD-P-00. The PRG for arsenic is 0.39 mg/kg; for chromium, the value is 30.1 mg/kg. Table 6-39 presents the data summary for those metals concentrations in sediment exceeding the respective PRG value.

VOCS and SVOCs

VOCs were detected in 10 surface water samples with reported values being primarily estimated concentrations (i.e., 'J' qualified). The maximum reported VOC concentration was 1.1 µg/L carbon tetrachloride. The PRG for carbon tetrachloride is 0.171 µg/L. No SVOCs were detected in surface water samples, as shown in Table 6-38.

No VOCs or SVOCs were detected above the PRGs in the sediment samples, as shown in Table 6-39.

PAHs and PCBs

PAH compounds exceeded PRGs in all 10 sediment samples with maximum concentrations in -SD-10-SD-P-00 and 6-SD-11-SD-P-00. The concentrations of benzo(b)fluoranthene in these samples were 990 µg/kg and 7,600 µg/kg, respectively. The PRG value for this compound is 148 µg/kg.

One PCB compound (Aroclor-1260) was detected in two sediment samples, 6-SD-10-SD-P-00 and 6-SD-11-SD-P-00. The concentrations were 260 µg/kg and 310 µg/kg, respectively. The PRG value for this PCB compound is 222 µg/kg. Table 6-39 presents the data summary for those compound concentrations exceeding the respective PRG value.

7.0 CONTAMINANT FATE AND TRANSPORT

The following section addresses the fate of eligible contaminants in the environment as well as their modes and propensity for transport in environmental media. The potential source zones for all OUs were discussed in Sections 4, 5 and 6. The following section describes the transport and ultimate fate of uranium compounds. The term "source material" for the purposes of this section is referring in a general way to material (e.g., soil, debris, and rubble) that provides a potential source of MED-related contamination and does not describe the uranium, thorium, or other materials licensed and regulated according to the Atomic Energy Act definition of source material.

7.1 Potential Routes of Migration in OU 1 - AOC 1 and AOC 2

AOCs 1 and 2 contain areas of former uranium refinement activities, and are source zones for MED contaminants. Figures 7-1 and 7-2 present the potential migration pathways for AOC 1 and AOC 2. The potential migration pathways applicable to these AOCs are described below.

Former Process Pipes Leaking Source Material Slurry into Soil. Evidence suggests that uranium peroxide slurry was piped from Building 845 (AOC 1) to Building 708 (AOC 2), and that this process piping leaked. The pipe was above-ground and entered the northwest corner of the second floor of Building 708. DOE attempted to remove slurry residue from the wall of the building before release of the building to DuPont. This process would have occurred prior to emplacement of impermeable cover materials.

Contaminants from Past Process Water to Sediments in the Drainage Ditches. A surface-water-to-sediment pathway may exist through settling of contaminants out of process water.

Contaminants to Subsurface Soils from Past Filling Operations: Contaminants may have been mixed with building debris and construction backfill from building demolitions in both AOCs.

Leaching of Contaminants by Infiltration from Near Surface Source Material to Surface Soil. This migration route encompasses near-surface source materials leaching into surface soils. Leaching of uranium from surface source material into the surface soils is a result of soluble

contaminants becoming mobile by rain-water infiltration and/or contaminated source material particles physically moving with the rain-water infiltration while it is percolating through the surface source material. This is a potential migration pathway for the uranium oxide materials encountered in the area of the former loading dock in AOC 1.

Leaching of Contaminants by Infiltration from Subsurface Source Material to Vadose Zone Soil. This migration route encompasses subsurface source material leaching into vadose zone soil. Leaching of uranium from subsurface source material into the vadose zone soil is the result of rain water infiltrating through the subsurface source material to the vadose zone soils. The subsurface source material to vadose-zone soils pathway is a potential migration pathway for the contaminants under the footprint of Former Building 708 in AOC 2.

Contaminants Leached from Source Material or Soil to Shallow Groundwater. This is a potential migration pathway for both AOC 1 and AOC 2. RI data indicate that the A Aquifer groundwater beneath both AOC 1 and AOC 2 has been impacted, but that B Aquifer groundwater is only impacted in AOC 2. The C Aquifer is not impacted by MED contaminants in any location.

Contaminants Migrating Downward from Shallow Aquifers to Deeper Aquifers. A migration pathway may exist whereby aqueous phase contaminants move into deeper aquifers.

Stormwater Runoff Carrying Contaminants from Source Materials to Surface Soils and to Drainage Ditches in AOC 3. This is a potential migration pathway for the Former Building 845 Area; however, it is limited due to the gravel cover that has been placed over this site. Pathways include contaminant migration from both source materials and impacted surface soils. This is currently not a potential migration pathway for AOC 2 because the area is currently covered by an impervious surface (asphalt); however, this may have been a potential migration pathway prior to paving of the area.

7.2 Potential Routes of Migration in OU 2 - AOC 3

AOC 3 contains the former main channel of the CDD that transported waste effluent from OU 1 to the settling basin. The CDD contains elevated uranium concentrations in the vicinity of OU 1 that may have been in waste effluent dating from the 1940s or was more recently washed in from

OU 1. Uranium occurs in sediments above the ISV in the wooden trough [22 pCi/g total uranium at two ft] and at the confluence of the wooden trough and the main channel of the CDD [98 pCi/g total uranium at two ft]. A surface sediment sample collected from farther down the CDD (3-SS-28) contained 80 pCi/g total uranium and is believed to be DuPont fluorspar waste based on results of mineralogical analysis and not related to MED uranium.

Figure 7-3 presents the potential migration pathways for the CDD. The pathways are described below.

Stormwater Runoff Carrying Contaminants from Source Materials to Surface Soils and Drainage Ditches. This is a potential migration pathway for AOC 3, as essentially all stormwater runoff from OU 1 goes to the CDD. The ditches in AOC 3 are downstream of AOC 1 and AOC 2 and upstream of the former settling basin. As discussed previously, MED contaminants are shallowly deposited in the former loading dock area of AOC 1, and could potentially erode away and wash into the AOC 3 ditches. The banks of the CDD have been stabilized in the area of OU 1 with asphalt, which may serve to reduce migration along this pathway. Sediments collected from the wooden trough area of the CDD had total uranium concentrations between eight and 98 pCi/g total uranium, while sediments from other areas of the CDD typically had less than seven pCi/g total uranium.

Contaminants in Sediments Migrating to Downstream Sediments Via Surface Water Transport. This potential pathway would relate to particulate contaminants that had previously been disposed into the CDD or washed into the ditch may then become mobile during erosion of the ditch. All particles will tend to move down-stream until they reach areas of lower stream energy, where they are deposited, and are covered by other sediments, but heavier particles like uranium-bearing compounds would be expected to require more stream energy than is needed to move natural sediments such as clay or quartz particles, resulting in winnowing of natural sediments away from heavier uranium particles.

Contaminants in Sediments Migrating to Surface Soils Via Flooding. This is a potential migration pathway for AOC 3, although sampling of surface soil has not detected elevated concentrations of uranium in AOC 3 surface soils.

Contaminants in Past Process Water Migrating to Sediments in the Drainage Ditch. This is a potential migration pathway for AOC 3. Geoprobe samples obtained during the RI of recently-deposited ditch sediments showed elevated uranium in ditch sediments ranging up to 98 pCi/g total uranium in the 'Wooden Trough' area. A sediment sample collected at station 3-SS-28 contained 80 pCi/g total uranium, but this sample appears to be from DuPont fluorspar feedstock rather than MED contaminants.

Contaminant Particles Dissolve into Groundwater. In AOC 3, water drains from the A Aquifer into the CDD. Conversely, hydraulic heads in neighboring B Aquifer wells are higher than the water level in the CDD stilling well. It therefore appears that contaminant particles in the CDD would dissolve into surface water rather than into groundwater, and that this pathway would not be a viable route for migration into deeper aquifers.

Contaminants Migrating Downward from Shallow Aquifers to Deep Aquifers. The AB aquitard appears to be continuous underneath the wooden trough and down the length of the CDD in the area of study until approaching the edge of the Lagoon area. Migration of either colloidal-phase or dissolved phase uranium compounds does not appear to have happened in AOC 3, since all occurrence of uranium compounds in OU 2 is shallow and consistent with the transport and deposition of particulates. There was no appreciable detection of uranium compounds in filtered water samples, and no appreciable detection of uranium compounds at the base of the A aquifer, at its interface with the clays of the AB aquitard.

7.3 Potential Routes of Migration in OU 2 - AOC 5

Potential migration pathways for AOC 5 are presented in Figure 7-4, however, it should be noted that no uranium concentrations in AOC 5 have exceeded the total uranium ISV of 14 pCi/g; therefore, these pathways are not considered as a primary migration route, due to the absence of potentially contaminated soil in this AOC.

7.4 OU 3, AOC 4 Lagoon Area

Potential migration pathways for AOC 4 are presented in Figure 7-5. No uranium has been detected in surface soils in AOC 4. One piece of uranium-impacted debris was recovered from approximately seven inches bgs during the GWS. The piece of debris was analyzed to confirm an anomaly noted in the walkover survey. Although the debris itself contained 11,700 pCi/g

total uranium, the nearby soils contained concentrations less than the ISV, indicating that the contamination does not appear to have migrated from the debris to the surrounding soils. Thus, none of the surface soil migration pathways presented in Section 7.1 appears to be applicable to AOC 4.

Contaminants Leaching from Subsurface Source Material to Groundwater (Shallow Aquifer). This is a potential migration pathway as the contaminated materials identified in AOC 4 are contained in the subsurface debris in SWMU 5 waste.

Contaminants Migrating Downward from the A Aquifer to the B Aquifer. This potential pathway exists, but wells installed in the B Aquifer do not contain elevated concentrations of MED contaminants.

Contaminants Moving From Groundwater to Surface Water. This is a potential migration pathway, as the current groundwater flow direction and proximity of the Delaware River indicate that aqueous uranium in AOC 4 could potentially migrate northward to the Delaware River. Groundwater flow direction in the A Aquifer is northward toward the Delaware River, while the flow direction in the B Aquifer is southward toward a DuPont recovery well. The zone of uranium-impacted groundwater is approximately 200 ft long and 150 ft wide. There are wells placed between the dissolved uranium area and the river that are not impacted by uranium, and several quarters of monitoring have indicated that the dissolved uranium is not migrating.

7.5 OU3, AOC 6 East Area

Potential migration pathways for AOC 6 are presented in Figure 7-6.

Contaminants Leaching from Subsurface Source Materials to Groundwater - This is a potential migration pathway for AOC 6 due to the presence of subsurface contamination in the soils and groundwater. In this AOC, the A Aquifer is not present, and the B Aquifer is the water table aquifer. A zone of aqueous-phase uranium has been identified in AOC 6, which appears to be coincident with the area of uranium-impacted soil.

Contaminants Migrating Downward from the Shallow Aquifer to Deeper Aquifers. Groundwater flow direction and V_S in the B Aquifer are controlled by the DuPont recovery

wells. The historical velocity and direction of groundwater flow here [that is, before the installation of the DuPont recovery system] is unknown. However, the single well containing elevated uranium concentrations in this AOC, Well 6-MW-01 (screened at the seven to 17 ft bgs interval), is surrounded by five wells that provide both horizontal and vertical control on potential migration. One of these wells, 6-MW-07, is screened below 6-MW-01 in the same aquifer, at the 40 to 50 ft bgs depth interval. Well 6-MW-07 was intended to provide vertical delineation of potential groundwater contamination. This well contains only background concentrations of aqueous uranium, indicating that there is no downward migration of uranium in the groundwater.

Stormwater Runoff Carrying Contaminants from Source Materials to Surface Soils and Drainage Ditches. This is a potential migration pathway due to the presence of uranium-impacted waste material on the slope of the drainage ditch in AOC 6. The total surface area of exposed waste is less than 100 ft^2. Visual observations suggest that the waste material has been eroding over time into the ditch sediments. Contaminants could then mix with sediment in the ditch, or sediments then mix with the surface waters in the ditch.

Contaminant Particles Dissolve into Groundwater. This potential pathway is supported by the presence of aqueous uranium in groundwater monitoring wells in AOC 6 (e.g. 6-MW-01).

Contaminants in Sediments to Surface Water Via Flooding. This is a potential migration pathway for AOC 6. Sampling of surface water [normally present only during storm events] did not show elevated uranium concentrations downgradient from AOC 6.

Contaminants Migrating from Sediments to Downstream Sediments via Surface Water. The drainage ditch provides a potential conduit for migration of contaminants in storm water and sediments. Surface water flow is not perennial in the AOC 6 ditch. The ditch flows during intermittent storm events. Sediment samples collected near the source zone contained elevated uranium, while downstream sediment samples contained near-background concentrations of uranium. Surface water samples were collected during a storm event and contained near-background uranium concentrations.

7.6 Contaminant Persistence in the Environment

This section discusses the persistence of uranium compounds in the environment. The factors contributing to the persistence of the uranium in the environment include the rate of natural decay of the isotopes, which compounds they occur in, and the propensity of the uranium compounds to sorb to soils.

7.6.1 Chemical Properties of Uranium

Unlike most organic compounds, metals are naturally occurring and, therefore are typically present in some degree in groundwater. Trace metals are mobile if soluble ions exist, the soil has a low cation exchange capacity, or if the metals are chelated or attached to a mobile colloid. Conditions that promote the maximum mobility of trace metals would include the presence of an acidic, clean, sandy soil, with a low organic and clay content (Fetter, 1998). The most important of these chemical properties affecting uranium mobility include redox status, pH, ligand (carbonate, fluoride, sulfate, phosphate, and dissolved carbon) concentrations, aluminum- and iron-oxide mineral concentrations, and uranium concentrations. Ander and Smith (2002) have stated that the redox potential of the geosystem is the primary controlling factor determining uranium solubility.

Uranium is found in six oxidation states ranging from U(1+) to U(6+), with tetravalent uranium [U(4+)] and hexavalent uranium [U(6+)] being the most common oxidation states of uranium in nature. The tetravalent form ordinarily occurs in reducing environments, while the hexavalent form is prevalent in oxidizing environments (USEPA, 1999). One researcher determined that the ratio of U(4+) to U_{nat} ranges from 3% to 7% in oxidizing groundwater and from 60% to 90% in anoxic conditions (Ervanne, 2004).

Uranium occurs in many different compounds, the most common of which include uranium oxides. The uranium oxide compounds pitchblende (black oxide) and uraninite (brown oxide) are the most common ore minerals of uranium (USNRC, 1978). These uranium compounds have been detected at OU 1; however, Chambers Works did not process raw uranium ores. Most likely, these compounds were deposited at OU 1 as intermediate byproducts of the uranium refinement process to produce compounds called "brown oxide" (UO_2) and "black oxide" (U_3O_8). The more mobile U(6+) compounds metastudtite and uranophane (a calcium-uranyl

silicate) were encountered in the "Yellow Oxide Area," which is at the former loading dock of Building 845 (Weston, 2003).

Metastudtite [UO_4•$2(H_2O)$ or $(U(O_2)\,|\,O\,|\,(OH)_2)$•$3H_2O$], or uranium peroxide dihydrate, was an intermediate that produced to dissolve uranium slimes and scrap prior to introduction into the Black Oxide Process. Metastudtite and the associated mineral studtite are the only peroxide-containing minerals (Burns and Hughes, 2003). Documented occurrences of metastudtite in the environment are uncommon. It was first identified as a naturally occurring mineral in 1983 (Deliens and Piret, 1983). It is thought to be formed naturally on the surface of uranyl oxides by the alpha-radiolysis of water (Burns and Hughes, 2003), and it forms readily in solutions in the presence of hydrogen peroxide and aqueous uranium (Kubatko, et.al., 2003). Metastudtite is thermodynamically unstable in the absence of dissolved hydrogen peroxide (ibid).

USEPA reports that uranium can form stable complexes with organic acids, thereby becoming mobile. The effective charge has been estimated to be about (3+) for U^{6+} in UO_2^{2+}. In general, (6+) actinides, including U^{6+}, would have approximately the same tendency to form humic- or fulvic-acid complexes as to hydrolyze or form carbonate complexes. USEPA suggests that the dominant reaction with the uranyl ion that will take place in a groundwater will depend largely on the relative concentrations of hydroxide, carbonate, and organic material concentrations (USEPA, 1999).

7.6.2 Heavy-Metal Transport Processes

Various transport processes control the migration of heavy-metal contaminants. Processes that tend to transport [and disperse] heavy metals include the following:

- Surface water transport
- Groundwater transport (advection).
- Dispersion in groundwater , which includes both mechanical mixing due to flow through soil, and diffusion in groundwater (dissolution from high concentrations to low concentrations)
- Colloid-facilitated transport.
- Leaching by dissolution or desorption.
- Surface erosion.

The aqueous solubility of a compound is considered the most important transport factor because it determines the concentration of the dissolved phase. Knowledge of the solubility of a chemical provides considerable insight into the fate and transport of that chemical. In general, highly soluble compounds are less likely to partition into soil or sediment, and are more likely to biodegrade (Montgomery, 1991). Thus, low-solubility uranium compounds like uraninite are less mobile in the environment than the high–solubility uranium compounds like uranium carbonates.

Contaminants can be transported in the dissolved phase in one of two ways: by advection or by dispersion. Advection involves transport of the contaminant with the flowing groundwater. Hydrodynamic dispersion has two components: molecular diffusion and mechanical dispersion. At low groundwater velocities, diffusion is predominant; at high velocities, dispersion is predominant. Molecular diffusion is the process by which ionic or molecular constituents move under the influence of concentration gradients. Mechanical dispersion is a function of dispersivity, and is dependent on vertical and horizontal permeability variations and the degree of aquifer heterogeneity and anisotropy; consequently, it is dependent on the nature of the medium (Walton, 1988). In unconsolidated soils, such as those found at the site, dissolved contaminants travel along pathways comprising interconnected pores between individual grains of sand, silt, and gravel. Advection is the primary transport mechanism for dissolved uranium onsite.

U^{4+} species dominate in reducing environments. U^{4+} tends to hydrolyze and form strong hydrolytic complexes. U^{4+} also tends to form sparingly soluble precipitates that commonly control U^{4+} concentrations in groundwater. U^{4+} forms strong complexes with naturally occurring organic materials. Thus, in areas where there are high concentrations of dissolved organic materials, U^{4+} organic complexes may increase U^{4+} solubility (USEPA, 1999).

Some of the secondary phases of uranium may form when sufficient uranium is leached from uranium oxides. In the presence of lignite and other sedimentary carbonaceous substances, uranium enrichment is believed to be the result of uranium reduction to form insoluble precipitates, such as uraninite. $UO_2(2+)$-phosphate complexes can be important in aqueous

systems with a pH between six and nine where the total concentration ratio of PO_4(total) / CO_3(total) is greater than 0.1 (USEPA, 1999).

Uranyl acetates, carbonates, and sulfates are among the most soluble. Uranyl nitrates are moderately soluble, while uranyl oxides, hydrides, and carbides are relatively insoluble. Complexes with sulfate, fluoride, and chloride are potentially important uranyl species where concentrations of these anions are high (ibid). In sulfate-rich oxidizing environments with low pH, uranyl sulfides are soluble (Brugger, et.al, 2003). Groundwater at OU 1 is relatively depleted in bicarbonate ion and the dominant cation is sulfate. Groundwater conditions at OU 2 also indicate low pH and high sulfate levels.

Sequential extraction analysis of OU 2 samples indicated that the uranium is not present as readily soluble compounds. A sample from the downstream end of the CDD (sample 3-SS-28-B-0-01) contained uranium compounds in the exchangeable fraction (Appendix R), thus where excess cations are present (for example Ca^{2+}, Mg^{2+}, and K^{+}) then uranyl ions may be mobilized. Uranium was also present in the carbonate fraction of the sequential extraction, indicating that the uranium would be mobile in weakly acidic conditions.

Colloid-facilitated transport involves the movement of small, solid-phase particles, macromolecules, or emulsions to which contaminants have adhered by sorption, ion exchange, or other means (Ryan and Elimelech, 1996). Heavy metals have a high affinity for mobile subsurface particles, and this attraction enhances their mobility (USEPA, 1989). Colloid-facilitated transport of uranium or radium has not been observed on-site. The possibility for this kind of transport was tested by comparing filtered and unfiltered aliquots of groundwater during low-flow groundwater sampling. The sampling indicated that heavy-metal colloids were not present.

Geochemical conditions in OU 2, AOC 3 are oxidizing and pH is neutral to slightly acidic. High sulfate and fluoride concentrations exist near the central portion of AOC 3. All of these conditions are favorable to the formation of colloids or complexes. The difference between uranium concentrations in filtered and unfiltered aliquots also suggest that uranium may be mobile here as a colloidal phase. Geochemical conditions in OU 1, AOCs indicate more

variability with neutral pH, high sulfate concentrations and oxidizing to slightly reducing conditions. In contrast, OU3 conditions indicate a strongly reducing environment, with pH neutral to slightly basic. Sulfate is predominant in the A aquifer while chloride predominates in the B aquifer.

7.6.3 Heavy-Metal Attenuation Processes

Processes that tend to attenuate the dispersion of heavy metals include retardation resulting from sorption, and precipitation. The sorption properties of individual solutes are dependent on soil and groundwater characteristics. In general, the relative amount of sorption onto inorganic soil material is as follows: clay > silt > sand > gravel (Walton, 1988). In OU 1, the subsurface soil profile includes the presence of a silty clay layer (named the AB Aquitard) over most of AOC 1 and AOC 2. The soils beneath the CDD in AOC 3 consist largely of silts and clays to a depth of seven ft beneath the bottom of the ditch. Beneath the silt and clay layer is a continuous unit of sand and gravelly sand, corresponding to the B Aquifer. The soil textures beneath AOC 5 (Building J-26) are of similar composition. Soil textures were primarily silt with discontinuous clay stringers that were encountered from approximately three ft to nine ft bgs. It would be expected that sorption may be an influence in retarding the migration of contaminants where these clay layers are present.

The soil partition or distribution coefficient (K_d) is defined as the ratio of sorbed chemical to the aqueous solute concentration. The coefficient indicates the propensity of a compound to partition between aqueous and solid phases and, therefore, provides a means for estimation of the relative mobility of solutes (or the degree of retardation) (Montgomery, 1991). Contaminants with high K_d values move slowly compared to the velocity of the groundwater.

Decay

Natural uranium consists of three isotopes: U-238, U-235, and U-234. Uranium-238 (half life 4.46 billion years), the most prevalent isotope in uranium ore (by weight), decays by alpha emission into Th-234 (half life 24.1 days), which itself decays by beta emission to P-234m (half life 1.17 minutes) which decays by beta emission to U-234 (half life 245,000 years). The various decay products, (sometimes referred to as "progeny" or "daughters") form a series starting at U-

238. After several more alpha and beta decays, the series ends with the stable isotope Lead-206 (Pb-206) as detailed in Table 7-1.

The production processes used at DuPont were for uranium refinement and not enrichment. Refined Uranium results from the chemical separation of uranium isotopes (beneficiation) from uranium ore, meaning that the daughter products have been removed. Some DuPont feedstock was beneficiated sodium diuranate received from Vitro Manufacturing Company of Canonsburg, Pennsylvania, which was shipped to Chambers Works for further refinement. However, most of the feedstock received by Chambers Works was uranium metal scrap from Electro Met and Mallinckrodt Chemical Works. It is believed that the sodium diurarante feedstock contained small percentages of Th-230 and Ra-226 impurities. The Refined Uranium isotopes remained at the activity fractions present in the uranium ore, which were approximately 48.9% U-234, 2.2% U-235, and 48.9% U-238. Isotopic analysis of samples of MED uranium at Chambers Works has confirmed that the U-234 is in isotopic equilibrium with the U-238 isotope.

Upon removal of the daughters, the short-lived decay progeny begin to grow into refined uranium concentrate product over time. Within months following chemical separation, the uranium concentrate contains U-234, U-235, and U-238 in full secular equilibrium with its short-lived progeny: Th-234, and Pa-234m. As time passes, Th-230 and Ra-226 will grow into the uranium as long-lived impurities. Thorium-230 has been detected above the detection limit in soil samples obtained from the areas of MED related contamination within the AOCs. The estimated in-growth of Th-230 after 66 years would result in a Th-230: U-238 activity ratio of 0.06%

Radium-226 is a daughter product in the decay chain of U-238 and is present in unrefined uranium ore. Radium-226 has been identified as a co-contaminant of uranium at other FUSRAP sites. A very small amount of Ra-226 would be present due to decay from MED U-238 daughters during the approximately 70 years that these wastes have been buried. The estimated in-growth of Ra-226 over the 66 years would result in a Ra-226: U-238 activity ratio 0.001%.

Sorption

Naturally occurring organic matter can serve as a possible sink for U(6+) in soils and sediments, and the sorption process may not be significantly reversible. This process may occur by the formation of stable complexes or by the reduction of U(6+) ions to more immobile U(4+) ions (USEPA, 1999). Radionuclides can preferentially sorb onto clay-sized particles (Jackson and Inch, 1983). However, uranium adsorption onto clay minerals is complicated and involves many factors. Sorption can also be correlated with pH values (Ryan and Gschwend, 1994 and USEPA, 1999). With all other factors held constant, the maximum sorption to aquifer solids occurs within the pH range of five to eight, with uranium becoming more mobile above and below this neutral range (USEPA, 1999).

In low ionic strength solutions with low U(6+) concentrations, aqueous uranyl concentrations will likely be controlled by cation exchange and adsorption processes (USEPA, 1999). The uranyl ion and its complexes adsorb onto clays, organics, and oxides. As the ionic strength of an oxidized solution increases, other ions (notably Ca(2+), Mg(2+), and K+) can displace the uranyl ion from soil exchange sites, forcing it into solution (Kubatko, et.al., 2003). For this reason, the uranyl ion is particularly mobile in high ionic strength solutions. Not only will other cations dominate over the uranyl ion in competition for exchange sites, but carbonate and sulfate ions can form soluble complexes with the uranyl ion, further lowering the activity of these ions while increasing the total amount of mobile uranium.

7.7 General Conceptual Site Model

The information presented in this Sitewide RI will be used to assess human health risk. As such, risk assessments must first identify what populations might be affected by potential risks in a specific area, both now and in the future. Exposures can only occur when a receptor can directly contact released constituents or when there is a mechanism for the released constituents to be transported to a receptor. A detailed Conceptual Site Model (CSM) describing the complete exposure pathways for each OU will be evaluated in the Risk Assessment. The intent of the CSM is not to describe a particular site exactly; instead, it is to be a more general description of the possible ways that humans might become exposed to contaminants at the site. A general overview of the CSM is presented below; detailed evaluations and identification of potential

receptors for each OU will be presented in the BRA. Figure 7-7 presents the general CSM for the FUSRAP Site.

Uranium contaminated soil (either surface or subsurface) is considered the primary potential source of contamination for the Site. The primary release mechanisms have been identified as surface-water runoff, infiltration/percolation of contaminated surface water, and particulate emissions from contaminated soil into the air. Transport mechanisms include groundwater, surface water, sediment, air and direct contact. External exposure to beta and gamma radiation from the radioactive decay of uranium and its daughter products could occur through non-contact exposure as a result of receptors being in proximity to contaminated media. Internal exposure routes identified for the general CSM include incidental ingestion of contaminated media; dermal contact with soil and sediments; and inhalation of contaminated dust. Groundwater as a source of potable or irrigation water will not be quantitatively evaluated in the risk assessment for the potential industrial worker receptors. However, a hypothetical residential receptor was evaluated in the risk assessment for comparison with the industrial worker results. For the hypothetical residential receptor risk associated with ingestion of groundwater was evaluated as shown in Figure 7-7.

8.0 SUMMARY AND CONCLUSIONS

This section presents summaries of geologic and hydrologic conditions for each operable unit, as well as summaries of the nature and extent of contamination from FUSRAP contaminants and a discussion of sampling results for other chemical contamination in soil and groundwater. Table 8-1 through Table 8-4 present the summaries of conclusions as related to the stated DQOs for each OU.

8.1 Summary of Geologic and Hydrogeologic Conditions

8.1.1 OU 1, AOC 1 Former Building 845 Area and AOC 2 F Parking Corral Area

Geologic Conditions

The upper six to eight ft of OU 1 soils consist of construction backfill and rubble. Soil textures are variable but are mostly silt and sandy silt. This upper unit corresponds to the A aquifer. Below eight ft, silt and clay lenses occur to a depth of approximately 10 ft in the northwestern portion of OU 1; however, this unit thins and may not be present in the extreme southwestern portion of OU 1. This depth interval corresponds to the A-B aquitard. Below 10 ft is a fining-upward sand unit with occasional gravel lenses. This unit extends to a depth of approximately 20 ft bgs and corresponds to the B aquifer.

Hydrogeologic Conditions

The A aquifer is present beneath OU 1. The A aquifer is composed of fill material and is subject to unconfined, or water table, conditions. Chambers Works does not regard this upper most water-bearing unit as a true aquifer due to the low production rates from wells screened in this unit, and from the fact that the soil consists entirely of rubble and fill material. Groundwater flow in the A aquifer is constrained by the CDD, which drains the A aquifer down-gradient of OU 1. The B aquifer consists of medium to fine sands and is interpreted to be Delaware River alluvium. The upper part of the B aquifer also appears to be partly draining to the CDD, although flow in the B aquifer is primarily to the northeast and is controlled by the DuPont groundwater recovery system. The B aquifer appears to be in communication with the Delaware River, based on the tidal fluctuations seen in B aquifer wells. The A aquifer wells show little to no tidal influence.

The piezometric surface in the A aquifer is on average one foot higher in elevation than the B aquifer in OU 1. Groundwater elevation in both the A and B aquifers are above the level of the CCD in OU 1. The groundwater flow gradient in the A aquifer appears to be largely dependent on the proximity to the CDD, but in the Dissolved Uranium Area the gradient is one foot / 100 ft (1%). The groundwater flow gradient in the B aquifer is much lower than in the A aquifer. The gradient near the Dissolved Uranium Area is 0.2 ft / 100 ft (0.2%).

8.1.2 OU 2, AOC 3 Central Drainage Ditch

Geologic Conditions

The soils beneath the CDD consist largely of silts and clays to a depth of seven ft below the bottom of the ditch. The silt and clay layer averages six ft in thickness in the western end of AOC 3 but thins to zero toward the east in the area of the basins. Beneath the silt and clay layer is a continuous unit of sand and gravelly sand. The soils beneath the wooden trough consist predominately of organic silts and clays, which are encountered from two ft to approximately seven ft beneath the trough bottom. Beneath this silt and clay layer are clean sands and gravelly sands.

The silt and clay layer corresponds to the A-B aquitard; while the sand/gravelly sand layer corresponds to the top of the B aquifer.

Hydrogeologic Conditions

AOC 3 lies approximately 1,000 ft from the bank of the Delaware River. The water flow direction of the CDD is eastward toward the B basin. The CDD averages 30 ft in width at the top of its bank. It has an approximate elevation of sea level (zero ft NAVD 88) at the base of the ditch. The water depth in the ditch averages one to two ft. The CDD appears to exhibit perennial water flow. Groundwater seeps have been noted on the banks of the CDD. The groundwater currently has a northeastward flow direction in the B aquifer. The CDD appears to drain the A aquifer and appears to recharge the B aquifer in AOC 3.

8.1.3 OU 2, AOC 5 Building J-26 Area

Geologic Conditions

At AOC 5, silts and clays are encountered from approximately three ft to nine ft bgs. However the silts and clays appear to be discontinuous, with intercalated fine sands. Poorly-graded medium-grained sand occurs near, and presumably under, the footprint of Building J-26.

Hydrogeologic Conditions

AOC 5 lies at an elevation of approximately five ft above sea level [NAVD 88]. The AOC 5 drains are used to collect storm water and direct it to the B Basin. The stormwater is eventually collected and treated in the DuPont WWTP. The drains usually contain water and surges in flow are observable that indicate the use of pumps to feed water into the drain. The groundwater currently has a northeastward flow direction in the B aquifer.

8.1.4 OU 3, AOC 4 Lagoon Area

Geologic Conditions

The soil textures encountered from ground surface to approximately five ft bgs are fine-grained sand and silty sand with occasional clay stringers and debris. This upper unit corresponds to the A aquifer. Organic clay and silt was encountered roughly from 10 ft bgs to 12 ft bgs, corresponding to the A-B aquitard. Below 12 ft bgs, fining-upward fine-to-medium grained sands were encountered, corresponding to the B aquifer. This sand unit contained occasional clay stringers.

Hydrogeologic Conditions

Within AOC 4, the groundwater flow direction in the A Aquifer is toward the Delaware River (i.e., northwest), while the groundwater flow direction in the B Aquifer is to be toward the interior of the site to the southeast. Soil textures are variable in the A Aquifer because these soils consist of debris, fill, and waste. Discounting the debris and waste, the average soil texture is fine-grained silty sand.

8.1.5 OU 3, AOC 6 East Area

Geologic Conditions

Soil textures in AOC 6 consist mainly of fine-grained sands with silt and clay stringers. The sand unit is fining-upward and is at least 50 ft thick.

Hydrogeologic Conditions

The depth to groundwater in AOC 6 is approximately eight ft bgs. This water table is the B aquifer; the A aquifer was not encountered in this area. Groundwater flow is to the southwest, toward a Chambers Works recovery well. Surface water flows to the east through the ditch that traverses the area. Water flows through the ditch in the eastern part of AOC 6 intermittently, during storm events

8.2 Summary of Potential Contamination at the Site

This section summarizes the findings of the Sitewide RI and draws conclusions based on available information. As discussed in Section 1.0, the purpose of this RI was to collect data necessary to adequately characterize each OU for developing and evaluating effective remedial alternatives.

8.2.1 Soil

OU 1 - AOC 1 Soils

A total of 56 soils borings were advanced (including 43 soil borings and 13 test pit borings) and 24 test pits were excavated in AOC 1. Seven concrete samples were also collected. Twenty-two soil boring locations, nine test pit boring locations and one concrete location contained total uranium above the ISV of 14 pCi/g. Thirty-one of the 130 soil boring samples (24%) analyzed for total uranium by either onsite or offsite gamma spectroscopy exceeded the ISV, with concentrations ranging from 14.1 pCi/g to 677.4 pCi/g (1BH034). Nine of the 14 test pit samples (64%) exceeded the ISV with concentrations ranging from 14.4 pCi/g to 27,600 pCi/g (1TP018). A concrete sample from location 1BH022 contained 28 pCi/g total uranium. The potential soil contamination has been estimated to encompass 1.1 acres of the 3.2 acres contained within AOC 1.

A uranium source zone has been identified as roughly coincident with the footprint of Former Building 845. This area of residual contamination extends north to the wooden trough and the northern area of AOC 1 where the CDD and wooden trough meet. Potential soil contamination above the ISV in this area was encountered to depths of 1.5 ft bgs and ranged from 85 pCi/g (1BH027) in the wooden trough to 127 pCi/g (1BH002) in the CDD area. The deepest soil sample exceeding the ISV beneath Former Building 845 was encountered at 4.5 ft bgs. The maximum soil concentration beneath Building 845 was in 1BH009 at 1.5 ft bgs (579 pCi/g total

uranium). The vertical extent of potential soil contamination beneath Building 845 was determined to be only within discrete sample intervals.

The area of the loading dock (Former Building 845) has been termed the 'Uranium Oxide Area'. Yellow uranium oxide compound has been encountered at ground surface in this area and appears to be localized in an approximate 100 ft^2 area near boring 1BH036. The highest uranium concentration was encountered in this area, from test pit sample 1TP018, where a sample containing 27,600 pCi/g was collected from the 1.5 to two ft bgs depth interval. Elevated uranium concentrations were also encountered in the area of the elevator shaft of Former Building 845. With the exception of the sample from 1BH036, the maximum total uranium concentration in soil from the Uranium Oxide Area was 677.4 pCi/g in boring 1BH034 at 1.5 ft bgs. Overall, potentially contaminated soils were detected at depths of up to 4.5 ft bgs in the Uranium Oxide Area.

In the southwestern portion of AOC 1, boring 1BH018 was potentially contaminated above the ISV from the surface to a depth of two ft bgs (149 pCi/g). The deepest soil sample exceeding the ISV in this area was collected at the 5.5 ft bgs interval during drilling of well 1-MW-17. The sample contained a total uranium concentration of 46 pCi/g. It has been noted that a storage shed occupied this location during MED usage. The area of soils with uranium above the ISV in this southwestern section of AOC 1 has been estimated at 0.1 acres.

The horizontal boundaries of potential uranium contamination for AOC 1 encompass the Uranium Oxide Area (including the area between the wooden trough and the east side of the building); potential residual contamination areas within and adjacent to the wooden trough and the CDD; and areas within the building footprint and to the west of the building. The outer grid samples collected during the RI defined the horizontal extent of potential contamination along the southern perimeter of the Former Building 845 Area. Delineation of contamination to the west of 1BH018 was completed with boreholes locations within the F Parking Corral Area (AOC 2). The vertical extent of potential contamination has been bounded by the identification of discrete depth intervals of potential contamination up to 4.5 ft bgs within the building footprint and the Uranium Oxide Area, and at the 5.5 ft bgs interval in the southwestern portion of the AOC.

Locations at the mid- and northern portions of the wooden trough, and along the bank of the CDD where the ISV was exceeded in the surface soil samples were further delineated by additional sample locations installed during the OU 2 field effort to define the horizontal extent of residual contamination along this ditch.

OU 1 - AOC 2 Soils

A total of 63 soil borings (including both biased and unbiased locations) were advanced and two test pits were excavated in AOC 2. Four concrete samples were also collected from three of the borehole locations. Nineteen soil boring locations contained total uranium above the ISV. Fifty-three of the 227 soil boring samples (23%) analyzed for total uranium exceeded the ISV, with concentrations ranging from 14.1 pCi/g to 16,548 pCi/g (2BH038). None of the concrete samples exceeded the ISV. No soil samples were taken from the test pits based on results from the direct radiation measurements. The potential soil contamination has been estimated to encompass 1.7 acres of the 8.5 acres contained within AOC 2.

The Former Building 708 has been identified as a source zone for soils, while the northern ditch and CDD area has been identified as a potential residual contamination area. For borings associated with Building 708, those located outside the building footprint exhibit soils potentially contaminated above the ISV at depths of less than 3.5 ft bgs, with a maximum concentration of 800 pCi/g in the 1.5 ft bgs interval (2-SB-07). Within the building footprint, potentially contaminated soils were detected to a maximum depth of 11 ft bgs, with the highest concentrations detected at four ft bgs. At this depth, concentrations ranged from 4,832 pCi/g (2BH018) to 16,584 pCi/g (2BH038). Between the 4.5 to seven ft bgs intervals, total uranium ranged from 23 pCi/g (2BH026) to 2,180 pCi/g (2-MW-02). Boring 2BH018 was potentially contaminated at a discrete depth of eight ft (19 pCi/g) while 2-MW-03 was potentially contaminated at the eight to 11 ft depth interval (1,050 pCi/g). Only two of the borings within the building footprint were potentially contaminated at discrete intervals, all other borings exhibited potentially contaminated soils across all depth intervals.

Depth of potentially contaminated soil in the northeast portion of the CDD was limited to the first 1.5 ft bgs, consistent with the depth of potential contamination detected along the CDD in AOC 1. Concentrations of total uranium in soil exceeding the ISV ranged from 132 pCi/g

(2BH020) to 385 pCi/g (2BH042). Another borehole (2-MW-020) located to the southeast of Building 708 contained a total uranium concentration of 238 pCi/g in the first six inches of soil.

The horizontal boundaries of potential uranium contamination in AOC 2 encompass the potential source area of the Former Building 708 and potential residual contamination areas within and adjacent to the northern drainage ditch and the northern portion of the CDD that traverses AOCs 1 and 2. The ISV was not exceeded in the outer perimeter grid locations. Surface soil samples associated with the northern portion of the CDD in AOC 2 exceeded the ISV; however, samples collected in the adjacent AOC were below the ISV, suggesting that contamination in the northern drainage ditch is limited to the southern side of the ditch. Additional horizontal delineation along the CDD to the east of Former Building 708 is not required as samples were collected at these locations under the AOC 1 investigation. The vertical extent of potential uranium contamination extends to a depth of 11 ft bgs, with highest activity observed in the two to four ft range.

OU 2- AOC 3 Soils

A total of 39 soils borings were advanced in AOC 3. Ten soil boring locations contained total uranium above the ISV. Ten of the 183 soil boring samples (5%) analyzed for total uranium exceeded the ISV, with concentrations ranging from 14.7 pCi/g to 365 pCi/g (3-SB-39).

The majority (seven of 10 locations) of the elevated uranium results was detected in the eastern portion of the CDD in current or former ditch locations at discrete depths up to eight ft bgs. The maximum concentration of 365 pCi/g was reported in boring 3-SB-39 at a depth of four to five ft bgs. This sample location is believed to be in a DuPont disposal cell area (SWMU 16), therefore the field effort was constricted in this area and no additional AOC 3 soil samples exist to the east 3-SB-39 for use in bounding potential soil contamination. There are additional soil sampling locations through the center of AOC 4 (OU 3) that help demonstrate that no MED uranium is present in the historical lagoon area.

In the eastern portion of AOC 3, potential soil contamination was detected at the six to seven ft bgs interval, with a maximum concentration of 39.3 pCi/g (3-SB-19). The presence of deep soil contamination in this area is most likely a result of historical lagoon deposits in the mid-1940's,

followed by subsequent filling operations during periods of construction. All potentially contaminated soils were located at discrete depths within each boring. In the western to southwestern portion of the CDD, potentially contaminated soils were located at shallower depths (less than four ft bgs) with a maximum concentration of 35.3 pCi/g in 3-SB-05.

OU 2 - AOC 5 Soils

A total of 11 borings were installed in AOC 5 and 61 soil samples were collected. Only one sample contained a detectable concentration of total uranium (2.3 pCi/g in 5-SB-05) and none of the sample concentrations were above the ISV. Historical records indicate that soils and foundations beneath former Building J-16 were excavated to a depth of 10 ft bgs. Data from this RI support those historical records.

OU 3- AOC 4 Soils

A total of 28 soils borings were advanced in AOC 4, of which eight locations exhibited soils exceeding the ISV. Seven of the 51 soil boring samples (14%) analyzed for total uranium exceeded the ISV, with concentrations ranging from 14.6 pCi/g to 355 pCi/g (4-MW-06). In addition, a surficial sample consisting of a piece of rubber (4CPT-62A) contained 11,700 pCi/g total uranium. Upon sampling the piece of rubber no further elevated uranium was detected in the adjacent area.

All locations exhibiting potentially contaminated soils were located in the AOI 1 (DuPont SWMU 5) area of AOC 4. SWMU 5 was a former landfill where Former Building J-16 waste was disposed. All potential soil contamination was at discrete intervals within each boring to depths of 10 ft bgs. The maximum concentration was 355 pCi/g total uranium in 4-MW-06 at eight ft bgs.

No elevated uranium activity was detected in any of the AOC 4 CPT down-hole gamma surveys, nor was it detected in the CPT confirmatory soil samples analyzed by the off site laboratory. An area of elevated gamma ray readings west of the lagoon identified during the GWS are typical for the types of surface materials present.

OU 3-AOC 6 Soils

The primary source of potential contamination in OU 3, AOC 6 is believed to be in the form of contaminated rubble, equipment and materials that were disposed after the demolition of MED buildings in OU 1.

A total of 49 soils borings were advanced in AOC 6, of which 18 locations within AOC 6-AOI 4 and four locations within AOC 6-AOI 6 exhibited soils exceeding the total uranium ISV. Of the 91 soil samples, 28 samples (31%) contained total uranium concentrations that exceeded the ISV of 14 pCi/g, with concentrations ranging from 15.7 pCi/g to 3,910 pCi/g (6-SB-04). The total area of soils impacted above the ISV in AOC 6-AOI 4 is approximately 4,800 ft^2 [0.1 acres].

Soils in AOC 6-AOI 4 were potentially contaminated above the ISV at depths less than four ft bgs. Most potentially contaminated soils were detected at discrete intervals within each boring; only two borings (6-SB-37 and 6-SB-38) were potentially contaminated between the surface and two ft bgs depth. The highest concentration of total uranium was from boring 6-SB-04 (3,910 pCi/g). A surficial soil sample (6CPT-62A) contained 1,280 pCi/g total uranium. Results from samples obtained from boring 6CPT21 (which had been selected for confirmation sampling due to the presence of elevated uranium during gamma logging) indicated a total uranium concentration of 69 pCi/g in the two to three ft depth. The remaining CPT confirmation samples were reported as NDs for the shallower soils.

Four locations in AOI 6 exhibited deeper soil contamination at discrete depth intervals between six and 12 ft bgs. The maximum total uranium concentration in this AOI was 153 pCi/g (6CPT-37) at 8.5 ft bgs). Location 6CPT37 has also been identified as a confirmation sample location during gamma logging. In addition, elevated gross gamma activity had been noted at the seven ft depth for locations 6-SB-19 and 6-SB-20 during logging. Analytical results for these locations and depths indicated a total uranium concentration of 71.3 pCi/g in 6-SB-19, and 72 pCi/g in 6-SB-20.

8.2.2 Groundwater

8.2.2.1 Radiological

OUs 1 and 2

Aqueous-phase uranium was encountered in both the A and B Aquifers within OU 1. In the AOC 1 area of the A aquifer, elevated total uranium is present in wells 1-MW-08A (average of 26,317 µg/L), 1-MW-10A (average of 109 µg/L), and 1-MW-18A (average of 1,091 µg/L). These wells are located within or adjacent to potential sources of uranium contamination (i.e. footprint of Buildings 845) or isolated potentially contaminated soil areas. The remaining AOC 1 A aquifer wells were, in general, less than five µg/L for total uranium

In the AOC 2 area of the A aquifer, the area of aqueous uranium impact is centered at wells 2-MW-02A, 2-MW-12A and 2-MW-15A (Dissolved Uranium Area). Well 2-MW-02A had the highest average total uranium value of 14,027 µg/L. Well 2-MW-15 averaged 331 µg/L total uranium, while well 2-MW-12-GU-P-02 averaged 168 µg/L. Consistent with AOC 1, the remaining wells in AOC 2 were, in general, less than five µg/L for total uranium.

Within the A aquifer, down-gradient control is provided by wells 1-MW-22A, 2-MW-19A, 2-MW-20A and 2-MW-24A. Up-gradient control is provided by well 1-MW-21A and 2-MW-26A. The horizontal extent of uranium impact to groundwater remains defined by the extent of uranium impact in soil. The extent of impacted groundwater is approximately 0.5 acres compared to the 5.85 acres encompassing OU 1.

In the B aquifer, uranium concentrations above the 30 µg/L MCL were encountered only in wells MW-03 and MW-05. These two wells are located in the 'Dissolved Uranium' area, and uranium concentrations averaged 29,560 µg/L and 167 µg/L, respectively. A well located downgradient (2-MW-04B) exhibited a single uranium concentration of 35.8 µg/L; all remaining samples from this location have been below the MCL and the average value for this well is 10 µg/L. There is no evidence that uranium has been mobilized and transported any significant lateral distance within the B aquifer.

Within the OU 1 B aquifer, down-gradient control is provided by well 2-MW-23B, while up-gradient control is provided by wells 2-MW-04B, 2-MW-05B, and 2-MW-16B. Vertical control

is provided by the C aquifer well (2-MW-25C), which has consistently shown no levels of uranium above the MCL. The maximum total uranium concentration was 1.42 µg/L. The extent of uranium impact to the groundwater within the B aquifer is very limited and covers a small area (approximately 0.2 acres) within the center footprint of the former Building 708. Soils with uranium concentrations above the ISV within the B aquifer are very limited in extent. The only location where soils exceed the ISV within the depth horizon of six to 20 ft is 2-MW-03B.

While soils exceeding the ISV were found in the OU2, AOC 3 soils investigation, there is essentially no aqueous-phase uranium present in monitoring wells located in OU 2; therefore, there is no potential for transport in groundwater. In addition, uranium concentrations in OU 2 ditch sediments and surface water are at background concentrations. No potentially contaminated soils and groundwater were reported in OU 2 AOC 5.

Six of the 13 A aquifer wells within OU 1 exhibited gross alpha results above the USEPA MCL of 15 pCi/L (maximum average concentration of 13,739 pCi/L in 2-MW-08). The maximum gross beta concentrations were reported for same sample (5,555 pCi/L). No average Ra-226/ Ra-228 concentration exceeded the MCL for combined Ra-226/Ra-228 of five pCi/L, and all Th-230 detections were less than one pCi/l.

The two OU 1 B aquifer wells impacted by uranium also exhibited elevated gross alpha and gross beta results, with the highest averages reported for well 2-MW-03 (11,743 pCi/L and 7,674 pCi/, respectively). Radium-228 results slightly exceeded the MCL for combined Ra-226/Ra-228 of five pCi/L in 2-MW-03, with an average concentration of 5.1 pCi/L. With a few exceptions, most Ra-226/Ra-228 data was reported less than one pCi/L. Thorium isotopes were detected in only a few samples, most notable 2-MW-03. An average Th-230 was reported in this sample at 3.93 pCi/L.

In the one C aquifer well (2-MW-25C) no radiochemical constituents exceeded the MCLs and no thorium isotopes were detected.

In addition to the radiological analysis, 25 monitoring wells from OU 1 and OU 2 were sampled for BTEX analysis during the first quarter sampling (July and August 2005), and a sample of LNAPL was collected from well 2-MW-01B in October 2005.

The MCL for benzene (five µg/L) was exceeded in 17 wells; the MCL for toluene (1,000 µg/L) was exceeded in six wells; the MCL for ethylbenzene (700 µg/L) was exceeded in 11 wells; and the MCL for xylene was exceeded in four wells. The LNAPL appears to be coal tar or coal tar distillate but does not contain uranium. The sample also contains the chlorinated solvents chlorobenzene and methylene chloride. Neither coal tar components nor chlorinated solvents are DuPont FUSRAP COPCs. Coal tar was historically used in dye production and coal tar distillation wastes have previously been identified through DuPont's RCRA investigations.

OU 3

In AOC 4, two wells in the A aquifer exhibited uranium concentrations above the MCL. Well I17-M01A had an average aqueous uranium concentration of 145 µg/L and is located adjacent to soil boring 4-SB-24, which contained potentially contaminated soils. Well 4-MW-06 had one sampling result that slightly exceeded 30 µg/L for total uranium. The reported concentration was 31.9 µg/L. The remaining values and the average concentration (22 µg/L) for this well have consistently been below the MCL. Well 4-MW-06 is cross-gradient to west of the uranium-contaminated area, and the average concentration for this location supports the conclusion that groundwater contamination has been bounded to the west, as evidenced by a review of the adjacent geoprobe sampling data showing uranium levels of 21 µg/L or less. All other A Aquifer wells within AOC 4 had uranium concentrations less than 10 µg/L.

Uranium contamination is bounded in the A aquifer by well I17-P01A (upgradient control) and wells 4-MW-02A and 4-MW-07A (downgradient control). Cross-gradient control is provided by wells 4-MW-05A and 4-MW-06A. None of the AOC 4 B aquifer wells contained elevated uranium concentrations.

In the A aquifer, gross alpha concentrations consistently exceeded the MCL of 15 pCi/L in well I17-MO1A with an average concentration of 67.6 pCi/L. The average gross beta concentration for this well was 71.8 pCi/L. No Ra-226/Ra-228 concentrations exceeded the MCL. In general,

most radium data was reported at less than one pCi/L. The thorium isotopes Th-228, Th-232, and Th-230 were detected infrequently in A aquifer groundwater, at reported values less than one pCi/L.

In the B aquifer, gross alpha was not detected above the MCL of 15 pCi/L and average values were below three pCi/L. Gross beta values were lower than those in the A aquifer, with averages of 9.3 pCi/L and 16.3 pCi/L. Most radium data was reported at less than one pCi/L; and all combined radium data was less than the MCL of five pCi/L. No Th-228 was detected; and Th-230 and Th-232 were reported in one sample each at concentrations less than one pCi/L.
The potential for transport of the aqueous-phase uranium in AOC 4 appear to be limited due to corrective actions undertaken by DuPont in this area to stabilize SWMU 5.

In AOC 6, well 6-MW-01B exhibited total uranium concentrations exceeding the MCL of 30 µg/L, with an average uranium concentration of 267 µg/L. The remaining wells in AOC 6 (6-MW-02B through 6-MW-07B) had uranium concentrations below the MCL, and all average values were below five pCi/L. Well 6-MW-01B is located downgradient of an area of potentially contaminated soils. Vertical delineation of potential groundwater contamination in this area has been bounded by well MW-6-07B, which is located adjacent to 6-MW-01B but is completed near the base of the B aquifer (50 ft bgs). In contrast, 6-MW-01B is completed to a depth of 17 ft bgs.

The MCL for gross alpha (15 pCi/L) was consistently exceeded in well 6-MW-01B. The average gross alpha concentration at this location was 119 pCi/L. The gross beta concentration averaged 58.5 pCi/L in this well. No Ra-226 or Ra-228 concentrations exceeded the MCL. With the exception of one Ra-228 value, all reported values were less than one pCi/L. Thorium-230 was detected in one well at a concentration of less than one pCi/L.

Uranium compounds are present near the surface of the drainage ditch in a discrete location and are susceptible to erosional processes. However, downstream sediment sampling did not detect any uranium concentrations greater than background.

8.2.3 Surface Water and Sediment

Surface water and sediment are only present within two AOCs (OU 2 – AOC 3 and OU 3 - AOC 6). Sample results are discussed in the following section. No surface water features or sediments are present at OU 1 (AOC 1 and AOC 2); OU 2 (AOC 5); and OU 3 (AOC 4). Therefore, no surface water or sediment samples were collected in these areas.

OU 2- AOC 3

No uranium was detected above the MCL in any of the 13 surface water samples obtained in AOC 3. The maximum reported total uranium value was 3.37 µg/L

Of the 31 sediment samples analyzed for total uranium, six samples exceeded the ISV, with all but one of these exceedances being reported from two locations within the 'wooden trough' area of the CDD. The maximum elevated uranium concentration in this area was 98.2 pCi/g. In contrast, the maximum uranium in sediment from other sampling locations along the CDD was 10.1pCi/g

The remaining sediment sample (3-SS-28) was the biased sample collected due to elevated activity identified during the walkover and analyzed for gamma-spectral activity in the on-site lab. Total uranium activity in this sample was 79.6 pCi/g. The results of SEM/XRD mineral analysis indicated that minerals detected in 3-SS-28 were consistent with fluorspar feedstock used to manufacture hydrofluoric acid. A DuPont hydrofluoric acid production area and gyp-cake disposal area (SWMU 34) were located in the general vicinity of where this sample was collected (north of this portion of the CDD).

No gross alpha concentrations exceeded the MCL. The maximum gross alpha concentration reported was 5.1 pCi/L and the maximum gross beta concentration (26.7 pCi/L) was detected in the same sample. None of the other radiological constituents were detected above one pCi/L. All sediment results for Ra-226 and Th-230 were reported at less than 1.5 pCi/g. Two locations contained Th-234 at concentrations of 14.8 pCi/g and 9.2 pCi/g. These are the same sediment locations containing the maximum total uranium concentrations.

OU3- AOC 6

Of the 12 surface water samples, the only exceedance of the total uranium MCL was detected at location 6-SW-02 (265 µg/L). Concentrations of total uranium values for the remaining 11 samples were reported at less than three µg/L. Of the 13 sediment samples, only the sample from location 6-SD-11 (18.4 pCi/g) exceeded the ISV of 14 pCi/g. Uranium concentrations in the remaining sediment samples ranged from 0.7 to 13 pCi/g.

The MCL for gross alpha (15 pCi/L) was exceeded at location 6-SW-02 (89 pCi/L). The maximum gross beta concentration for this location was 83 pCi/L. The combined MCL for Ra-226/Ra-228 (five pCi/L) was not exceeded in the surface water samples. No Th-228 or Th-230 was detected; one Th-232 value was reported at less than one pCi/L. In the sediment, all radiological data was reported as less than two pCi/g, with the exception of one Th-232 sample (9.7 pCi/g) detected in sample 6-SD-11.

8.3 Conclusions

Through an iterative process of soil, groundwater, surface water and sediment investigations at the Chambers Works Site, the nature and extent of radiological contamination has been identified for six AOCs within the three FUSRAP OUs. Potential source areas and contaminant migration pathways have also been identified. Tables 8-1 through 8-4 presents the summary of conclusions as related to the stated DQOs for each OU and media.

In summary, the results of the RI indicate that the largest extent of potentially contaminated soils and groundwater are located within the boundary of OU 1. Soil locations containing elevated concentrations of total uranium are associated with identified source zones (i.e., former building footprints and the Uranium Oxide Area). The potential soil contamination has been estimated to encompass 1.1 acres of the 3.2 acres contained within AOC 1, and 1.7 acres of the 8.5 acres contained within AOC 2. While both the A and B aquifers have been impacted within OU1, the extent of groundwater contamination is limited (0.5 acres within the A aquifer and 0.2 acres within the B Aquifer). The contaminated wells are located within or adjacent to identified potential sources of uranium contamination or isolated potentially contaminated soil areas. No uranium impacts to the C aquifer were observed. Geochemical conditions within both aquifers

in OU1 are indicative of slightly reducing conditions, which may serve to limit the solubility and subsequent migration of uranium compounds.

The OU 2 soil investigation results indicated that discrete areas of potentially contaminated soil exist within the eastern portion of the CDD in current or former ditch locations and adjacent to DuPont's SWMU 16, the former C Basin (a closed disposal cell under RCRA). RI sampling efforts inadvertently located one soil boring location within this disposal cell (3-SB-39). This sample is not considered as defining the extent of MED contamination since other radioactive materials, not related to MED, are likely found in this closed cell. This sample is not included within the BRA data set. Potential sediment contamination was limited to the 'wooden trough' area of the CDD. No potential soil contamination was found in AOC 5. While no groundwater contamination was identified within OU 2, geochemical conditions in AOC 3 are oxidizing and suggest that uranium could be mobilized here.

Potentially contaminated soils and groundwater are also located within OU 3, although to a lesser extent than in OU 1. Within AOC 4, all locations exhibiting potentially contaminated soils were located in the AOI 1 (DuPont SWMU 5) area. Within AOC 6, only two of seven areas of interest (AOI 4 and AOI 6) contained potentially contaminated soil. The total area of impacted soils in AOC 6-AOI 4 is approximately 4,800 ft^2 [0.1 acres], while the extent within AOC 6 AOI 6 is limited to discrete intervals at 4 sampling locations. Soils with uranium concentrations above the ISV in AOI 6 were typically encountered between 6.5 to 10.5 ft bgs.

Results of the surface water and sediment sampling within AOC 6 indicated that there are essentially no impacts, and that any potentially contaminated soils washed into the ditch have not migrated. The single surface water sample (of 13 collected) that exhibited elevated total uranium was turbid and was collected near MED related uranium existing at the surface of the northern bank of the ditch. Only one of 13 sediment samples contained elevated uranium.

Groundwater contamination within the A aquifer is limited to one well in AOC 4 which is located within a uranium-impacted area and adjacent to an identified area of potentially contaminated soils. The A aquifer is not present in AOC 6; the extent of groundwater contamination within the B aquifer in this portion of OU 3 is also limited to one well located

downgradient of an area of potentially contaminated soils. The estimated extent of impacted groundwater is 3,000 to 5,000 ft^2, or less than 0.1 acre. Similar to OU1, groundwater geochemistry indicates the presence of reducing conditions.

The BRA has been prepared in conjunction with this RI (submitted under separate cover) to assess the exposure pathways and potential human health and ecological risks associated with the identified levels of contamination in each OU. The information contained in the RI and BRA will be utilized in the FS which will assess remediation requirements and identify potential remedial alternatives.

9.0 BACKGROUND REFERENCE AREA

Sampling was conducted in order to determine background concentrations for the naturally occurring radionuclides present at the Chambers Works Sites that are also Eligible Contaminants in the FUSRAP-contaminated areas. In addition, background concentrations were determined for naturally occurring metals. This information will be used for identifying contaminants of concern, and in support of evaluation of risk in the BRA.

This section summarizes the sampling effort for soil, groundwater, surface water and sediment; provides background locations, analytical results and the evaluation of final background concentrations.

9.1 Methodology

The methodologies presented in USEPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA 540-R-01-003; OSWER 9285.7-41, September 2002) and Navy's guidance document *Handbook for Statistical Analysis of Environmental Background Data* (NAVFAC 1999) were used during the determination of background concentration for radionuclides and metal. Other reference materials used during this evaluation include the following:

- *Risk Assessment Guidance Document for Superfund*, Part A (USEPA 1989c)
- *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (USEPA 1992)
- *Guidance for Conducting Risk Assessments and Related Risk Activities for the DOE-ORO Environmental Management Program* (University of Tennessee, 1999).
- *Nondetects and Data Analysis- Statistics for Censored Environmental Data* (Helsel, R. Dennis 2005)

The following methodologies were implemented during the background evaluation. They include:

- Collection of background samples for various environmental media
- Review of background sampling results for all analytes and identifying potential outliers present at the site
- Determination of background concentrations for each FUSRAP-eligible contaminants in each environmental media.

9.2 Collection of Background Samples for Various Environmental Media

This step involves identifying which sampling locations are appropriate for use as background. These sampling locations have the same basic characteristics as the Site sampling locations in the six AOCs, but are in areas unlikely to have received MED releases. For soils, the background samples have similar texture and particle-size distributions as the Site samples. For groundwater, the background wells were completed in the same hydrostratigraphic unit as the Site wells. Candidates for inclusion in the background dataset include samples from areas believed to be nonimpacted (e.g., for groundwater, wells located up-gradient of the Site). These "background locations" were selected based on the conceptual site model, knowledge of on-site and off-site potential contaminant sources, the nature and extent of known soil and groundwater contamination, and any other factors relevant to an understanding of the Site. The following sections of the report summarized the background sampling locations for various environmental media at the Site.

9.2.1 Soil Investigation

As a part of the background evaluation process, a background location was selected for collecting samples that are appropriate for use as background. The selected location was selected to have similar physical, chemical, geological, radiological, and biological characteristics as the survey unit being evaluated. The location is approximately 200 ft southwest of AOC 6, in a vacant lot of approximately two acres in size (as shown on Figure 9-1). The selected area has a similar history to the other AOCs in that it was marshland before Chambers Works use, was infilled with rubble, and built over with buildings that have now been demolished. Background radionuclide concentrations were expected to vary more than unused ground, but the objective of the background survey was to capture the radionuclide variability of this industrial site minus MED impact, rather than capture radionuclide variability minus industrial impact.

A total of 20 background soil samples were collected and analyzed. Sample locations are shown on Figure 9-2. Ten of the discrete background soil samples were collected from zero to 0.5 ft bgs and 10 were discrete samples collected from 0.5 to 10 ft bgs. Consistent with the sampling in MED-impacted areas of the Site, the soil samples were scanned with GM and NaI detectors to provide background count rate information for detectors that were being used to scan potentially

impacted samples collected during the RI. Individual analytical results are presented in Appendix F.

9.2.2 Groundwater

Groundwater samples were collected from the B Aquifer only, as the B Aquifer is far more likely to be used as a future water supply than the A Aquifer. Unfiltered groundwater grab samples were collected from the 10 geoprobe soil borings in the background reference area, as shown on Figure 9-2. Temporary piezometers equipped with pre-packed five foot screens were installed in each boring to facilitate the groundwater sampling. The screened interval for each well was 10-15 ft bgs. Consistent with the sampling in MED-impacted areas of the Site, the depth to groundwater was measured prior to sampling, and measurements noted on the well installation log. The well installation logs for the background reference area piezometers are included in Appendix C-1. Groundwater stabilization parameters were also measured during the purging of each well prior to sampling.

The background groundwater samples were analyzed for radionuclides and metals, as discussed in Section 2.6.2.2**.** Analytical laboratory data is presented in Appendix H-1.

9.2.3 Surface Water and Sediment

Ten background (upstream) surface water samples were collected from a drainage ditch located at the eastern boundary of the reference area, as shown on Figure 9-2. These locations are hydraulically upgradient of the Site. Similarly, 10 background sediment samples were collected from the same locations as that for surface water. The sampling crew collected the grab samples in depositional areas along the main flow line of the water body because contaminants tend to concentrate in the fine-grained sediments in depositional zones.

These media were analyzed for radiological constituents and metals, as discussed in Sections 2.6.1.2 and 2.6.2.2. Analytical laboratory data is presented in Appendix P.

9.3 Review of Background Sampling Results

The sampling results for background samples were reduced and evaluated prior to performing the statistical analysis. The data were evaluated following the general guidance provided in USEPA's *Guidance for Data Quality Assessment* (USEPA, 2000) to ensure that they are of the right type and quality for use. Results qualified with an "R" designation, and quality control

samples were removed from each of the datasets. Only unfiltered groundwater results were used in the background calculations for groundwater.

9.4 Statistical Determination of Background Values

There are a variety of statistical approaches that are applicable to calculating background criteria, depending on the number of samples and the distribution type of the data. This evaluation used two upper-end statistics, such as the 95% upper tolerance limit (95% UTL) and the 95% upper prediction level (95% UPL), to represent background. The UTL represents a value that 95% of the population will fall below with 95% confidence and the UPL represents an estimate of a threshold value in the upper tail of the data distribution. The 95% UPL method is recommended in *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities* (USEPA 1992) and in other USEPA guidance.. US EPA's *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (USEPA 540-R-01-003; OSWER 9285.7-41, September 2002) utilizes UTL for background screening.

The method used for determination of the background value depends on sample size, the distribution type (i.e., parametric or nonparametric), and the detection frequency for each analyte. There must be an adequate number of background samples to determine the 95% UTL and 95% UPL. If there are insufficient detected sample results (i.e., less than five samples), the maximum detected value will be used as the background concentration for that analyte.

Prior to the calculation of the background 95% UTL and 95% UPL, the data were reviewed through the use of an outlier test to determine if there were outliers in the dataset. As a rule, results were not deleted as outliers unless a very compelling reason is identified (i.e., suspected field or laboratory problems or it is an extreme outlier).

The process of calculating the 95% UTL and 95% UPL concentration for each analyte began with the determination of the frequency of detection and the distribution type (parametric or nonparametric). A parametric UTL and UPL were calculated for those background sample sets that are normally or lognormally distributed. A nonparametric UTL and UPL can be calculated when the distribution of the background sample set is unknown. A description of how the

background criteria were calculated based on the frequency of detection and the sample distribution is presented below:

- If the frequency of detection is greater than 85%, but less than 100%, sampling results of non-detect samples were substituted by half of the detection limit, and then based on the results of distribution, 95% UTL and 95% UPL were determined.
- If the frequency of detection is <85%, non-parametric statistics were utilized to calculate the 95%UTL and 95% UPL.

ProUCL version 4.0 was used to determine the distribution of sampling result for each analyte. Since 95% UTL represents a 95% of the upper confidence limit of the upper 95th percentile, a 95% UTL should be greater than or equal to the corresponding 95% UPL ProUCL prefers the use of 95% UPL as an estimate of background threshold value. Initially, Dixon's outlier test was utilized to identify the potential outlier present within the dataset. However, the outliers presented within the background dataset are detected samples with no s uspected field or lab problem; hence they were included during the determination of distribution of sampling results. If the distribution of sampling results is determined to be normal or lognormal, then the 95% UTL and 95% UPL concentrations were calculated parametrically. If the results indicate that the distribution of sampling results is neither normal nor lognormal at the 95% level of confidence, then the 95% UTL and 95% UPL concentrations were calculated non-parametrically. The 95% UTL and 95% UPL concentrations were then compared to the maximum detected background concentration and the smallest of these three concentrations was used as the background criteria. The use of the lower of the concentrations (95%UTL, 95% UPL, versus the maximum detected) is consistent with the method outlined in the *Guidance for Conducting Risk Assessments and Related Risk Activities for the DOE-ORO Environmental Management Program* (University of Tennessee, 1999).

9.4.1 Soil

9.4.1.1 Radionuclides

Analytical sample results and statistical determinations of background values for radionuclides in both surface soil and subsurface soils are presented in Table 9-1. All radionuclides were detected in both surface and subsurface soils in more than five samples; therefore, background determinations were calculated as described above, based on the distribution of sample results.

9.4.1.2 Metals

Analytical sample results and statistical determinations of background values for metals in surface and subsurface soils are presented in Table 9-2. In surface soils, one metal (antimony) was not detected in any samples; therefore, no background values were calculated for this analyte. Four metals were detected in less than five samples; therefore the background value was calculated as the maximum detected value. These analytes are beryllium, cadmium, silver and thallium.

In subsurface soils, no background values were determined for three metals (antimony, silver and thallium), as they were not present in any samples. An additional three metals (beryllium, cadmium, and mercury) were detected in five or less samples. Background values for these analytes are the maximum detected concentration.

The remaining metals were detected in both surface and subsurface soils in more than five samples; therefore, background determinations were calculated based on the distribution of sample results.

9.4.2 Groundwater

9.4.2.1 Radionuclides

Analytical sample results and statistical determinations of background values for radionuclides in groundwater are presented in Table 9-3. All radionuclides except Ra-228 were detected in more than five groundwater samples, and background values calculated based on the distribution of sample results. Ra-228 was detected only once, therefore, the background value for this analyte is the maximum detected concentration.

9.4.2.2 Metals

Analytical sample results and statistical determinations of background values for metals groundwater are presented in Table 9-4. Ten out of 19 metals were reported as non-detects; therefore, no background values were determined for those analytes. Four metals (barium, lead, nickel and zinc) were detected in less than five samples, and the corresponding background value was set to the maximum detected concentration of each respective analyte.

The remaining metals were detected in groundwater in more than five samples; therefore, background determinations were calculated based on the distribution of sample results.

9.4.3 Surface Water and Sediment

9.4.3.1 Radionuclides

Analytical sample results and statistical determinations of background values for radionuclides in surface water and in sediments are presented in Tables 9-5 and 9-6, respectively. Four radionuclides (Ra-228, Th-228, Th-230 and Th-232) were not detected in surface water, and no corresponding background values were calculated. Two analytes (Ra-226 and U-235) were detected in less then five samples, and the calculated background was equal to the maximum detected concentration. The remaining radionclides were detected in more than five samples and background values were calculated based on the distribution of sample results.

All radionuclides except Ra-228 were detected in more than five sediment samples, and background values calculated based on the distribution of sample results. Radium-228 was detected only once, therefore, the background value for this analyte is the maximum detected concentration.

9.4.3.2 Metals

Analytical sample results and statistical determinations of background values for metals in surface water and sediment are presented in Tables 9-7 and 9-8, respectively. Six out of 19 metals were not detected in surface water samples, and no background values were calculated. Seven metals were detected in five or less sediment samples, and the corresponding background values were determined to be the maximum detected concentration for each respective analyte.

Two metals (beryllium and thallium) were not detected in sediment samples. No background values were determined for these analytes. Another two metals (antimony and silver) were detected in less than five sediment samples; therefore, the background concentration was determined to be the maximum detected value.

The remaining metals were detected in surface water and sediment in more than five samples; therefore, background determinations were calculated based on the distribution of sample results.

9.5 Summary

Background evaluations were performed to determine background concentrations for the naturally occurring radionuclides present in surface and subsurface soil, surface water, sediment, and groundwater at Chambers Works Sites that are also Eligible Contaminants in the FUSRAP contaminated areas. In addition, background concentrations were determined for naturally occurring metals present in these media. As a part of this background evaluation, background locations were identified and media-specific sampling activities were conducted.

For an analyte with less than five detected sampling results, the maximum detected concentration was chosen as the background concentration. For analytes with more than five detected samples, USEPA approved software ProUCL version 4.0 was utilized to identify any outlier present within the sampling results for each radionuclide and chemical analyte. However, the identified outliers are detected samples with no suspected field or lab problem. Therefore, they were included in determining the distribution of sampling results. Based on the distribution of sampling results, the software determined the 95% UTL and the 95% UPL for each radionuclide and metal analyte at various environmental media. As a conservative approach, the minimum value of 95% UTL, 95% UPL, and the maximum detected concentration was considered to be the background concentration for that analyte in that medium. Table 9-9 presents the background concentrations for each analyte present within various environmental media at the Site.

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TABLES

Table ES-1
Summary of Investigative Methods

Investigation Method	Operable Unit 1	Operable Unit 2	Operable Unit 3	Background Reference Area
Sampling Strategies				
MARSSIM strategy	X	X	X	X
Systematic grid	X	X	X	X
Biased sampling	X	X	X	
Geophysical				
Electromagnetic	X	X		X
Ground Penetrating Radar	X	X	X	X
Magnetometer			X	X
Metal Detector			X	
Gamma Walkover	X	X	X	
Soil Core Scans				
Down-Hole Gamma Logging	X	X	X	X
Down-Hole Spectral			X	
Gieger-Mueller	X	X	X	X
Onsite vs Offsite Analytical Analysis				
Onsite Laboratory Analysis	X	X		
Offsite Laboratory Analysis	X	X	X	X
Subsurface soil				
Geoprobe/Direct Push	X	X	X	X
Hollow-Stem Auger	X			
Rotosonic Drilling	X	X	X	
Cone Penetrometer Testing			X	
Concrete Sampling	X			
Test Pits	X			
Groundwater				
Temporary Peizometers	X	X		X
Geoprobe Hole Sampling			X	
Monitoring Wells	X	X	X	
Water Level Measurements	X	X	X	X
Slug Tests	X	X	X	
Surface Water				
Dip Cup Method		X	X	X
Sediment				
Geoprobe/Direct Push		X	X	X
Ecological Investigations				
Historical Records Review	X		X	X
Site Visit		X	X	
Potential Wetlands Determination		X	X	

Table ES-2
Summary of Nature and Extent

Operable Unit 1, AOC 1 (Building 845 Area) and AOC 2 (F Corral)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Define the horizontal and vertical extent of MED-related contamination in AOC 1soil	Horizontal Extent ▪ The uranium source area is identified as the footprint of the former Building 845 (foundation and elevator shaft remain after building was demolished in 1999). ▪ Impacted soil above the ISV is identified primarily within the Building 845 footprint and immediate vicinity with the exception of a few isolated surface areas. ▪ Highest uranium concentrations are found in the area of the former loading dock and the elevator shaft. ▪ Isolated areas of shallow contamination (primarily to less than 1 foot bgs) were found in the northern portion of AOC 1, in the wooden trough and an isolated area in the southwest corner of AOC 1 at the location of a former storage shed. ▪ The location of the former storage shed showed elevated uranium concentrations (149 pCi/g) at a depth of 1 foot bgs (1BH018). ▪ The horizontal extent of contamination was defined by the remaining perimeter sample locations. The ISV was not exceeded in the outer perimeter locations with the exception of isolated surface sample. ▪ Area of impacted soil is approximately 1.1 acres.	Horizontal delineation is completed. In areas where outermost boring exceeds the ISV, adjacent AOC samples have bounded the limits of contamination (AOC 2 samples bound elevated uranium in the southwestern portion of AOC 1; AOC 3 samples assist in bounding contamination to the north and east. Three discrete areas are impacted above the ISV.
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily at shallow depths (less than 4.5 feet bgs) in the area of the former Building 845. ▪ The highest U concentration was observed to be 27,600 pCi/g at 1.5 feet bgs (1TP018) in the area of the former loading dock.	▪ No data limitations ▪ Vertical delineation completed.
Define the horizontal and vertical extent of MED-related contamination in AOC 2	Horizontal Extent ▪ The uranium source area is identified as the footprint of the former Building 708. ▪ Impacted soil above the ISV is identified primarily within the Bldg 708 footprint and immediate area. ▪ Perimeter grid samples defined the horizontal extent of contamination in AOC 2. The ISV was not exceeded in the outer perimeter grid locations. ▪ Samples taken from locations in the vicinity of the CDD show uranium concentrations above the ISV (2BH043, 2BH042, 2BH020, 2-MW-20A) ▪ Locations where the ISV for total uranium was exceeded are located within or adjacent to the source zone (former Building 708 or the residual surface contamination where the drainage ditch discharges to CDD).	▪ No data limitations ▪ Horizontal and vertical extent delineated
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily beneath the building footprint at depths between 0-8 feet bgs. ▪ The highest total uranium concentration was 16,600 pCi/g at 3 feet bgs within the Dissolved Uranium Source Area (2BH038). Maximum vertical extent of contamination in AOC 2 soils is 12 feet bgs. Samples from 2-MW-25 bound the maximum vertical extent.	

Table ES-2
Summary of Nature and Extent

Operable Unit 1, AOC 1 (Building 845 Area) and AOC 2 (F Corral)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Identify the horizontal and vertical extent of aqueous uranium in OU 1	Horizontal Extent ▪ Monitoring well program was designed to confirm the extent of aqueous uranium and evaluate the mobility of uranium in groundwater. Areas of groundwater contamination are contained within the boundaries of the OU, are located where elevated concentrations in soil are also found, and have not migrated over the last 65 years. ▪ Aqueous-phase uranium was encountered in both the A and B aquifers but is observed primarily in the shallow, A aquifer. ▪ Three discrete areas of groundwater contamination in the A aquifer have been identified with uranium concentrations exceeding the MCL of 30 µg/L (used for evaluation purposes). These areas are within the footprint of the former MED buildings (AOCs 1 and 2) and a location of a former storage shed in the southwest portion of AOC 1. ▪ The horizontal extent of aqueous uranium is estimated to cover approximately 0.5 acres and 0.2 acres in the A and B aquifers, respectively.	▪ No data limitations ▪ Recommend continued routine monitoring of wells in OU 1
	Vertical Extent ▪ In OU 1 the vertical extent of uranium has been determined to be primarily in the A aquifer except for a limited area of groundwater contamination in the B aquifer in AOC 2 within the Dissolved Uranium Area (footprint of former Building 708). Sampling of the C aquifer in this area of AOC 2 has consistently shown no further vertical migration of uranium into the C aquifer. ▪ Aqueous uranium contamination in AOC 2 is observed in the area of 2-MW-03 in the B aquifer. Downgradient movement of uranium has not been observed. However, the most recent sampling from 2-MW-05B (upgradient of 2-MW-03) indicated elevated uranium (1,019 µg/L). This was the only quarter where concentrations exceeded the MCL of 30 µg/L; the previous 4 quarters had been well below the MCL.	▪ No data limitations ▪ Recommend continued routine monitoring of wells in OU 1.

Operable Unit 2, AOC 3 (Central Drainage Ditch) and AOC 5 (Build J-26 Area)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Define the horizontal and vertical extent of MED-related contamination in AOC 3	Horizontal Extent ▪ The uranium source areas are in OU 1 and consist of soil contamination associated with uranium processing operations at former Buildings 845 and 708. ▪ Soil above the ISV is identified at three locations in the upper reaches of the CDD and east of the wooden trough (3-SB-09, 3-SB-05, and 3-SB-31). Two sediment samples in the wooden trough had U concentrations above the ISV at 3-SB-04 and 3-SB-02. ▪ Uranium concentrations in the lower reaches of the CDD exceeded the ISV at six locations within the current drainage ditch, the historical run of the ditch, and to the south of the historical ditch. ▪ Sample results with uranium concentrations less than the ISV bound the northern edge of the AOC. Isolated sample locations show uranium concentrations above the ISV in the area of the wooden trough (3-SB-31) and in the CDD between AOC 1 and AOC 2 (3-SB-05) ▪ Lateral extent of contamination is limited to the historical extent of CDD.	Horizontal delineation identifies three discrete areas where soils are contaminated above the ISV: the wooden trough; the lower reaches of the CDD and a discrete sediment sample in the middle portion of the CDD (3-SS-28). Sample at 3-SS-28 is believed to be DuPont fluorspar used in the production of hydrofluoric acid.

Table ES-2
Summary of Nature and Extent

Operable Unit 2, AOC 3 (Central Drainage Ditch) and AOC 5 (Build J-26 Area)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily at shallow depths (less than 3.0 feet bgs) in the upper reaches of the CDD and 8 feet bgs in the lower reaches. ▪ The highest total uranium concentration in the upper reach was 35 pCi/g at 3.0 feet bgs (3-SB-05); 80 pCi/g at 0.5 feet bgs (3-SS-28) in the middle of the CDD; and 41 pCi/g at 7 feet bgs (3-SB-26) in the lower reach. The deepest contamination in the lower reaches was at 3-SB-20 (33.7 pCi/g) in the 6-8 ft bgs interval. ▪ Sample 3-SB-39 contained the highest uranium concentration detected in AOC 3 (365 pCi/g). This sample location near SWMU 16, a closed DuPont disposal cell and may not be representative of the extent of FUSRAP-related contamination within AOC 3.	▪ No data limitations ▪ Vertical delineation completed.
Define the horizontal and vertical extent of MED-related contamination in AOC 5	Horizontal Extent ▪ No MED-related uranium was encountered in soil above the ISV in AOC 5. ▪ Highest uranium concentration was 3.38+/-2.02 pCi/g in sample 5-SB-05 (one foot bgs) Vertical Extent ▪ No MED-related uranium was encountered at depth in soil above the ISV in AOC 5. ▪ Highest uranium concentration was 2.3+/-1.4 pCi/g in sample 5-SB-05 (10 feet bgs)	▪ No data limitations ▪ RI project goals met
Identify the horizontal and vertical extent of aqueous uranium in OU 2	There is no impact to groundwater in AOC 3 or AOC 5	▪ No data limitations ▪ RI project goals met

Operable Unit 3, AOC 4 (Historical Lagoon Area)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Define the horizontal and vertical extent of MED-related contamination in AOC 4 soil	Horizontal Extent ▪ The uranium source areas are identified as contaminated materials disposed of in the AOC. Edges of lagoon were filled in and built up with both DuPont and MED rubble/debris. Lab waste from OU 2 (Building J-26 Area) was reported to be buried in AOI 1, DuPont SWMU 5. ▪ Soil above the ISV is identified at seven locations in AOI 1 with six of the seven locations in the area of the disposal cell (SWMU 5), south of the slurry wall. One location to the north of AOI 1 (4-MW-05) showed an uranium concentration only slightly above the ISV at 15 pCi/g (3 feet bgs). ▪ No results exceeding the ISV were confirmed in AOI 2 soils, located within the eastern portion of AOC 4.	▪ No data limitations ▪ Horizontal delineation is completed. Three discrete areas have uranium concentrations above the ISV.
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily within the upper 10 feet bgs. ▪ Highest uranium concentration in soil at AOI 1 was 355 [+/-60] pCi/g at 8 feet bgs (4-MW-06A). ▪ No exceedance of the ISV was identified in AOI 2 soils.	Vertical delineation is complete in AOC 4.

Table ES-2
Summary of Nature and Extent

Operable Unit 3, AOC 4 (Historical Lagoon Area)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Confirm the horizontal and vertical extent of aqueous uranium in AOC 4	▪ Uranium contamination is highly localized. Elevated uranium has been detected in one well in the A aquifer, (I17-MO1A) in AOC 4. ▪ The extent of aqueous uranium contamination within the existing boundaries of DuPont's SWMU 5 has been identified as a zone of uranium-impacted groundwater in the A aquifer approximately 200 feet long and 150 feet wide.	▪ No data limitations ▪ RI project goals met

Operable Unit 3, AOC 6 (East Area)		
RI Goals	**Summary of RI Findings and Conclusions**	**Data Limitations/ Recommendations**
Define the horizontal and vertical extent of MED-related contamination in AOC 6 soil.	<u>Horizontal Extent</u> ▪ The uranium source area is identified as East Burial Area currently located under East Road. MED scrap and waste were buried there with DuPont radioactive waste. ▪ Soil above the ISV is identified primarily under East Road, in an area directly north of East Road, and in an area to the northeast of the source zone. 13 locations in the area of East Road; 5 locations north of East Road; 4 locations northeast of the source zone in AOI 4. ▪ Maximum U concentration in soil in AOI 4 was 3910 [+/- 460] pCi/g at 1 foot bgs under East Road (6-SB-04). ▪ One grab sample from the bank of the ditch was collected at 6-CPT-62A and reported 1280 pCi/g at 1 foot bgs. ▪ Highest sediment sample from the source zone was 18 pCi/g [+/- 3]; all remaining sediment samples upstream and downstream were below the ISV, ranging from 0.7 – 13 pCi/g total uranium. Area impacted above the ISV is approximately 0.1 acres.	▪ No data limitations ▪ RI project goals met
	<u>Vertical Extent</u> ▪ ISV exceedances reported in 18 samples in AOI 4, to a depth of 4 foot bgs. ▪ Highest activity in AOI 4 at 1 foot bgs was 3,910 [+/- 460] pCi/g ▪ Five exceedances in AOI 6 between 6 and 12 feet bgs, ranged from 37.3 pCi/g to 153 pCi/g.	▪ No data limitations ▪ RI project goals met
Confirm the horizontal and vertical extent of aqueous uranium in AOC 6	Uranium contamination is highly localized. Elevated uranium has been detected in one well in the B aquifer (6-MW-01B).	▪ No data limitations ▪ RI project goals met

Table 1-1
Detailed Project Goals for Sitewide RI

Overall RI/FS Project Goals:

- Characterize each Operable Unit (OU) by collecting sufficient samples (soil, groundwater, surface water, and sediment) to adequately confirm the presence and extent of uranium concentrations greater than the ISV. The ISV is 14 pCi/g for total uranium (7 pCi/g U-238). The derivation of the ISV is provided in Subsection 2.4.6.4 of the Final QAPP (WESTON/Cabrera, 2002b). Drinking water standards were used as screening criteria for surface water and groundwater.
- Identify potential migration pathways through which constituents may affect human health and the environment and identify potential receptors of these constituents.
- Determine the level of risk present due to any release identified in the site characterization phase and the level of risk present due to any identified receptors in migration pathways.
- Identify sites that are candidates for no further action based on the findings of the above objectives.
- Identify sites that are candidates for interim or final cleanup actions, including removals.
- Identify sites that are candidates for long-term monitoring only.
- Identify the samples necessary to evaluate potential remedial technologies for sites requiring an interim or final cleanup action, including removals.
- Characterize waste streams for disposal.

RI Sampling and Analytical Project Goals:

SOILS:

- Confirm historical results of potential radiological contamination and further define surface and subsurface soil MED-related radiological contamination within the defined AOCs for each OU.
- Confirm and define the horizontal and vertical extent of MED-related contamination in soils in OU's 1, 2 and 3 using the ISV.
- Confirm historical results and further define the extent of MED-related radiological contamination in the concrete and subsurface soils within OU 1, AOC 1, Former Building 845.
- Identify potentially co-disposed radioactive contaminants.
- Collect sufficient number of samples to evaluate the mobility of ROPCs.
- Obtain adequate number of systematic grid and biased samples and obtain analytical results from both on-site and off-site laboratories of the required precision and accuracy (achieve data quality/usability requirements as specified in the QAPP) to perform the risk evaluation using the appropriate radiological model.
- Characterize background concentrations of naturally-occurring radionuclides that are FUSRAP Eligible contaminants.
- Evaluate relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.
- Address data gaps concerning the concentrations of non-eligible contaminants in order to characterize chemical risks for the Baseline Risk Assessment.

Table 1-1
Detailed Project Goals for Sitewide RI
(cont.)

GROUNDWATER:

- Achieve the required analytical sensitivity to compare with the ISV and potential screening criteria for groundwater (drinking water standards for total uranium, total radium, and gross alpha).
- Obtain additional site physical feature data such as observed fluctuations in water levels.
- Obtain stratigraphic and hydrogeological data to better define pathways such as preferential shallow groundwater flow and the extent and nature of near-surface fill materials.
- Determine the horizontal and vertical extent of aqueous uranium in groundwater at DuPont's Solid Waste Management Unit (SWMU) 5 (OU 3).
- Test for the presence of uranium peroxide dihydrate in groundwater samples (OU 1 and OU 3).
- Confirm the vertical extent of aqueous uranium in confirmed areas of contamination (OU 1 and OU 3).
- Determine whether there are seasonal variations in the direction or flux of the groundwater in the "A" and "B" aquifers (OUs 1, 2 and 3);
- Determine the nature of tidal flux in SWMU 5 (OU 3).
- Sample for other contaminants that may have been produced under MED contracts or for health and safety reasons (organic intermediates, aromatics, petroleum constituents, fluorochemicals, polymers, elastomers, thorium, and possibly specialty chemicals) (OUs 1, 2 and 3).
- Sample light nonaqueous phase liquid (LNAPL) for uranium (OU 1).
- Evaluate uranium mobility (OUs 1, 2 and 3).
- Evaluate flow direction and gradient of the "A" aquifer and vicinity (OUs 1, 2 and 3).
- Evaluate flow direction and gradient of the "B" aquifer and vicinity (OUs 1, 2 and 3).
- Establish up-gradient "baseline" locations to compare with the groundwater results of the down-gradient wells, recognizing that groundwater across the DuPont Chambers site has been impacted by numerous contaminants (OUs 1, 2 and 3).
- Evaluate the potential pathway of impacted groundwater to surface water in the drainage ditches (OUs 1, 2 and 3).
- Characterize background concentrations of naturally-occurring radionuclides that are FUSRAP-eligible contaminants
- Address data gaps concerning the concentrations of non-eligible contaminants to characterize chemical risks for the Baseline Risk Assessment

ECOLOGICAL :

- Conduct an ecological assessment of AOC 3 and AOC 4

Chemical Constituents Investigation Project Goals:

- Determine the type and concentration of chemical contaminants present in the media impacted by site radiological operations to characterize IDW for disposal purposes.
- Determine chemical contaminants present in media impacted by site radiological operations to characterize chemical risks for the Baseline Risk Assessment.
- Characterize soils and groundwater for geotechnical and geochemical parameters to provide data to evaluate mobility and adsorption properties of these media with respect to total uranium.
- To determine the volume of soil exceeding radiological ISV that may potentially qualify as a RCRA hazardous waste.

Table 1-2
DuPont Chambers Works Med Manufacturing History

Project/ Contract No.	Date (s)	AOC	MED Project Description
Project 9233 Contract W-7412-Eng. 8	Begins July 1943	n/a	Commercial production of hydrofluoric acid for use in the fluorine generators. Initial acid production 300,000 pounds/ month. Production was a Kinetic Chemicals facility located north of AOC 3.
Project 9595 Contract W-7412-Eng. 2	Begins April 1943	1	Production of 117,032 pounds of n-perfluoroheptane in the Blue Products Area, referred to as Process Buildings A and B (OU 1).
Project 9634 Contract W-7412-Eng.3	April 1943 - May 1946	2	Converted sodium diuranate, commercial black oxide, and uranium peroxide dihydrate to brown oxide in Buildings 708 and 205 (AOC 2). The brown oxide was then converted to green salt, which, in turn, was converted to uranium metal. Green salt and uranium metal production were suspended in August 1944, and brown oxide production in May 1946. Total production had been 1,970 tons of brown oxide, 608 tons of green salt, and 232 tons of uranium metal.
Project 9757	Begins December 1943	6	This production was located on 21 acres in the East Area (AOC 6). Total production included 3.9 million pounds of hexadecafluoro-dimethylcyclohexane, 286,000 pounds of monochlorohexadecafluoro- dimethylcyclohexane, 8,200 pounds of fluorolube, and an unknown quantity of C_7F_{16}.
Project 9803 Contract W-7412-Eng.22	August 1943 - December 1945	1	This project was located in the "Blue Products" area (AOC 1), and included recovery of scrap uranium and by-products of other uranium process (uranium metal sludge, uranium metal dross and slag from the green salt/ magnesium reaction) and their conversion first into uranium peroxide dihydrate and then to the end product, black oxide. Approximately 982 tons (1,964,000 lbs) of black oxide was produced.
Contract W-7412-Eng.151	Unknown	5	Conducted research and development activities at the former Building J-16 (AOC 5). T he demolished Building J-16 was disposed of in the Historical Lagoon A area (AOC 4).
Contract W-7412-Eng.161	Unknown		Freon 113® produced under MED contract. Production of 79,850 pounds of Freon 113®.

n/a – Not Applicable (Outside of AOCs)

Table 2-1
Summary of Investigative Methods

Investigation Method	Operable Unit 1	Operable Unit 2	Operable Unit 3	Background Reference Area
Sampling Strategies				
MARSSIM strategy	X	X	X	X
Systematic grid	X	X	X	X
Biased sampling	X	X	X	
Geophysical				
Electromagnetic	X	X		X
Ground Penetrating Radar	X	X	X	X
Magnetometer			X	X
Metal Detector			X	
Gamma Walkover	X	X	X	
Soil Core Scans				
Down-Hole Gamma Logging	X	X	X	X
Down-Hole Spectral			X	
Gieger-Mueller	X	X	X	X
Onsite vs Offsite Analytical Analysis				
Onsite Laboratory Analysis	X	X		
Offsite Laboratory Analysis	X	X	X	X
Subsurface soil				
Geoprobe/Direct Push	X	X	X	X
Hollow-Stem Auger	X			
Rotosonic Drilling	X	X	X	
Cone Penetrometer Testing			X	
Concrete Sampling	X			
Test Pits	X			
Groundwater				
Temporary Peizometers	X	X		X
Geoprobe Hole Sampling			X	
Monitoring Wells	X	X	X	
Water Level Measurements	X	X	X	X
Slug Tests	X	X	X	
Surface Water				
Dip Cup Method		X	X	X
Sediment				
Geoprobe/Direct Push		X	X	X
Ecological Investigations				
Historical Records Review	X		X	X
Site Visit		X	X	
Potential Wetlands Determination		X	X	

Table 2-2
Selection Criteria for Soil Borings in OU 1

Location	Original Reason for Selection	Field Changes
AOC1 Former Building 845 Area		
1BH001	Systematic grid sample	
1BH002		
1BH003		
1BH004		
1BH005		
1BH006		
1BH007		
1BH008		
1BH009		
1BH010		
1BH011		
1BH012		
1BH013		
1BH014		
1BH015		
1BH016		
1BH017		
1BH018		
1BH019		
1BH020		
1BH021		
1BH022		
1BH023		
1BH024	Biased sample based on gamma walkover data	
1BH025		
1BH026	Systematic grid sample	
1BH027		
1BH028		
1BH029		
1BH033		
1BH034	Biased sample based on gamma walkover data	
1BH035		
1BH036		
1-SB-01	Biased sample targeting source zones where total U expected to be approximately 100 pCi/g	
1-SB-02		
1-SB-03		
1-SB-04		
1-SB-05		
AOC 2 F Parking Corral		
2BH001	Systematic grid sample	
2BH002		
2BH003		
2BH004		
2BH005		
2BH006		
2BH007		

Table 2-2
Selection Criteria for Soil Borings in OU 1 (cont.)

Location	Original Reason for Selection	Field Changes
2BH008/ 2BH008R	Systematic grid sample	Offset based on geophysical and utility maps
2BH009		
2BH010		
2BH011		
2BH012		
2BH013R		Offset based on geophysical and utility maps
2BH014/ 2BH014R		Offset based on geophysical and utility maps
2BH015/ BH015R		Offset based on geophysical and utility maps
2BH016		
2BH017		
2BH018/ BH018R		Offset based on geophysical and utility maps
2BH019/ 2BH019R		Offset based on geophysical and utility maps
2BH020		
2BH021R		Offset based on geophysical and utility maps
2BH022		Offset based on geophysical and utility maps
2BH023/ BH023R		Offset based on geophysical and utility maps
2BH024		Offset based on geophysical and utility maps
2BH025		
2BH026		Offset based on geophysical and utility maps
2BH027/ BH027R		Offset based on geophysical and utility maps
2BH028		
2BH029R		Offset based on geophysical and utility maps
2BH030		
2BH031/ 2BH031R		Offset based on geophysical and utility maps
2BH032		
2BH033		
2BH034		
2BH035R		Offset based on geophysical and utility maps
2BH036R		Offset based on geophysical and utility maps
2BH037		
2BH038/ 2BH038R	Biased sample based on gamma walkover data	Offset based on geophysical and utility maps
2BH039		
2BH040		
2BH041		
2BH042		
2BH043		

Table 2-2
Selection Criteria for Soil Borings in OU 1 (cont.)

Location	Original Reason for Selection	Field Changes
2-SB-06	Biased sample targeting source zones where total U expected to be approximately 100 pCi/g	
2-SB-07		
2-SB-08		
2-SB-09		
2-SB-10		

Table 2-3
Selection Criteria for Soil Borings in OU 2

Location	Original Reason for Selection	Field Changes
AOC 3 Central Drainage Ditch		
3-SB-01	Centerline of CDD in previously-remediated section between AOC 1 and AOC 2.	Moved to centerline of wooden trough
3-SB-02		Moved to centerline of wooden trough
3-SB-03		Moved to centerline of wooden trough
3-SB-04		Moved to centerline of wooden trough
3-SB-05		This section of the CDD is enclosed in twin concrete culverts, so the boring location was moved ~10 ft north of the centerline to avoid contacting the culverts.
3-SB-06	Centerline of CDD	Original lat/long position was 20 ft west of bank of CDD. Location was moved to centerline of CDD.
3-SB-07		Pipe obstruction. Moved downstream 30 ft to intersection of present CDD and historical run of CDD.
3-SB-08	Historical location of CDD	
3-SB-09		
3-SB-10		
3-SB-11	Centerline of CDD at confluence of CDD and 'the wooden trough'.	Moved ~10 ft downstream because of obstruction by a railroad bridge.
3-SB-12	Centerline of CDD	
3-SB-13		
3-SB-14		
3-SB-15		
3-SB-16		
3-SB-17		
3-SB-18		
3-SB-19		
3-SB-20	At historical location of the CDD	
3-SB-21	Not originally specified	~20 ft off centerline of CDD to see any lateral variations.
3-SB-22		~20 ft off centerline of CDD to see any lateral variations.
3-SB-23		~20 ft off centerline of CDD to see any lateral variations.
3-SB-24		~20 ft off centerline of CDD to see any lateral variations.
3-SB-25		At historical location of the CDD
3-SB-26		In wetlands area ~20 ft off centerline of historical CDD to see any lateral variations.
3-SB-27		~20 ft off centerline of historical CDD to see any lateral variations.
3-SB-30	Biased sample targeting source zones where total U expected to be approximately 100 pCi/g	
3-SB-31		
3-SB-32		
3-SB-33		
3-SB-34		
3-SB-35		
3-SB-36		
3-SB-37		
3-SB-38		
3-SB-39		
3-SS-28	Not originally specified	Biased **surface (represents sediment) sample** (rather than a boring) collected where the gamma survey indicated an elevated count rate.

Table 2-3
Selection Criteria for Soil Borings in OU 2 (cont.)

Location	Original Reason for Selection	Field Changes
AOC 5 Former Building J-16		
5-SB-01	Historical ditch location	**Cancelled.** Utility obstructions. Not a useful groundwater-sampling location.
5-SB-02		**Cancelled**. Utility obstructions. Not a useful groundwater-sampling location.
5-SB-03		
5-SB-04		
5-SB-05		
5-SB-06		Moved 20 ft northeast (utility obstructions). No longer in historical ditch location but still useful for groundwater sampling.
5-SB-07		Moved 10 ft east (utility obstructions). No longer in historical ditch location but still useful for groundwater sampling.
5-SB-08		Moved 8 ft southwest (utility obstructions). Sampling location is still in the historical ditch
5-SB-09		
5-SB-10		
5-SB-11		
5-SB-12		**Cancelled**. Utility obstructions. Not a useful groundwater-sampling location.
5-SB-13		Moved ~70 ft to another historical ditch location.
5-SB-14		**Cancelled**. Utility obstructions. Not a useful groundwater-sampling location.
5-SB-15		Moved ~30 ft to another historical ditch location.

NOTE: **BOLDED** sample location indicates cancelled location

Table 2-4
Selection Criteria for Soil Borings in OU 3

Location	Original Reason for Selection	Field Changes
AOC 4 - Historical Lagoon A		
4CPT01	Locations along the perimeter of the Lagoon as seen in the 1950s aerial photograph. Near a channel visible in a 1940 photograph. Also near	
4CPT02		
4CPT03	Sampling locations within the boundary of what was Lagoon A in the 1940s, based on aerial photographs.	
4CPT04		
4CPT05		
4CPT06		
4CPT07		
4CPT08		
4CPT09		
4CPT10	Sampling locations within the boundary of what was Lagoon A in the 1940s, based on aerial photographs.	
4CPT11		
4CPT12		
4CPT13		
4CPT14	Within and just north of the southern berm of lagoon, as seen in 1940s – 1950s aerial photographs. Area actively filled in 1940s and 1950s.	
4CPT15		
4CPT16		
4CPT17		
4CPT18		
4CPT19	This area was identified by a former DuPont employee as the area where portions of Building 845 (known MED building) were buried in the 1950s after its demolition.	
4CPT20		
4CPT21		
4CPT22		
4CPT23		
4CPT24		
4CPT25		
4CPT26		
4CPT27		
4CPT28		
4CPT29		
4CPT30	Northeast perimeter of lagoon from 1942 onward, based on aerial photographs.	
4CPT31		
4CPT32		
4CPT33		
4CPT34		
4CPT35		
4CPT36		
4CPT37	Locations along the perimeter of the lagoon as seen in the 1950s, based on aerial photographs. Appears to be areas of fill operations during the 1940s – 1950s.	
4CPT38		
4CPT39		
4CPT40		
4CPT41		
4CPT42		Site moved due to proximity to overhead power lines.
4CPT43		
4CPT44		
4CPT45		
4CPT46		Site moved due to proximity to overhead power lines.
4CPT47		

Table 2-4
Selection Criteria for Soil Borings in OU 3 (cont.)

Location	Original Reason for Selection	Field Changes
4CPT48		
4CPT49	Locations along the perimeter of the lagoon as seen in the 1950s, based on aerial photographs. Appears to be areas of fill operations during the 1940s – 1950s.	
4CPT50		
4CPT51		
4CPT52		
4CPT53		
4CPT54		
4CPT55		
4CPT56		
4CPT57		Site moved due to proximity to buried gas and water lines.
4CPT58		
4CPT59		
4CPT60		
4CPT61	Added due to elevated gamma walkover measurements in eastern part of AOC.	
4CPT62	Added due to elevated gamma walkover measurements in northern part of AOC.	
4CPT63		
4-SB-31	Biased sample targeting source zones where total U expected to be approximately 100 pCi/g	
4-SB-32		
4-SB-33		
4-SB-34		
4-SB-35		
4-SB-36		
4-SB-37		
4-SB-38		
4-SB-39		
4-SB-40		
AOC 6 - East Burial Area		
6CPT01	In 1944 a small ponded area or lagoon was visible with an east/west trending drainage between the lagoon and the berm north of East Road. In 1946 this area appeared to be undergoing fill and grading.	
6CPT02		
6CPT03		
6CPT04		
6CPT05		
6CPT06	This area was a landfill throughout the 1940s and the area continued to have ground disturbance and apparent fill activities through the 1950s when the buildings of project 9757 were apparently dismantled.	
6CPT07		
6CPT08		
6CPT09		Very thick rubble layer around 9 feet. 7 attempts were needed to set a sleeve (refer to CPT methodology in Section 2.2.3.1).
6CPT10		
6CPT11		
6CPT12		

Table 2-4
Selection Criteria for Soil Borings in OU 3 (cont.)

Location	Original Reason for Selection	Field Changes
6CPT13	In 1951, the area was disturbed ground that appeared to be a fill area.	
6CPT14		
6CPT15		
6CPT16		
6CPT17		
6CPT18		Heavy rubble area, 5 attempts needed to set sleeve (refer to CPT methodology in Section 2.2.3.1).
6CPT19		
6CPT20	In 1983, Bechtel conducted gamma walkover and site sampling of the area. Elevated radiological constituents were reported in this area.	
6CPT21		
6CPT22		
6CPT23		
6CPT24		
6CPT25		
6CPT26		
6CPT27		
6CPT28		
6CPT29		
6CPT30	After buildings were removed in the 1950s, this area was seen as disturbed ground possibly a fill area.	
6CPT31		
6CPT32		
6CPT33		
6CPT34	Location of possible fill activities in the 1940s based upon aerial photos. Apparent fill operations became increasingly active throughout the 1950s especially in the most eastern part of the site. The largest area of disturbance/fill was noted in the 1959 aerial photograph.	
6CPT35		
6CPT36		
6CPT37		
6CPT38		
6CPT39		
6CPT40		
6CPT41		
6CPT42		
6CPT43		
6CPT44		
6CPT45		
6CPT46		
6CPT47		
6CPT48	During the 1940's the area was mostly covered by wetlands and standing water except for a small amount of fill activity at the southern most part. During the 1950's, the wetlands/standing water area was reduced by the continued fill activities until it was completely filled as visible in the 1959 aerial photograph.	DuPont could not clear site.
6CPT49		
6CPT50		
6CPT51		
6CPT52		
6CPT53		
6CPT54		
6CPT55		
6CPT56		
6CPT57		
6CPT58		
6CPT59		
6CPT60		
6CPT61		Location substituted for 6CPT48

Table 2-4
Selection Criteria for Soil Borings in OU 3 (cont.)

Location	Original Reason for Selection	Field Changes
6CPT62	Added due to elevated gamma walkover measurements.	
6CPT63		
6CPT64		
6CPT65		
6CPT66		

Table 2-5
Selection Criteria for Soil Borings in the Background Reference Area

Location	Original Reason for Selection	Field Changes
Background Reference Area		
7-SB-01	Systematic grid sample	
7-SB-02		
7-SB-03		
7-SB-04		
7-SB-05		
7-SB-06		
7-SB-07		
7-SB-08		
7-SB-09		
7-SB-10		

Table 2-6
Monitoring Well Construction Details

Parameter	A Aquifer Wells	B Aquifer Wells	C Aquifer Wells
Total Boring Depth *	~6 ft	20 ft	40 ft
Borehole Diameter *	8.25 in.	8.25 in.	12 in.
Total Well Depth *	6 ft	20 ft	40 ft
Casing Type / Size	4-in. Sch. 40 PVC	4-in. Sch. 40 PVC	4-in. Sch. 40 PVC double cased in an 8-in. casing
Screen Type / Size	4-in. Sch. 40 PVC 0.010-in	4-in. Sch. 40 PVC 0.010-in	4-in. Sch. 40 PVC 0.010-in
Screened Interval *	3.5-5.5 ft	9.5-19.5 ft	29.5-39.5 ft
Cased Interval *	0-5.5 ft	009.5 ft	0-29.5 ft
Filter Pack	20-40 washed silica	20-40 washed silica	20-40 washed silica
Seal Interval *	2-3 ft	8-9 ft	28-29 ft
Placement of Centralizer(s)	1 @ bottom	Bottom and top of screen	Bottom and top of screen
Surface Construction	Field box on 2' x 2' pad	Field box on 2' x 2' pad	Field box on 2' x 2' pad

Notes:

* All depths measured from ground surface

ft - feet

in. = inches

Sch. 40 PVC = Schedule 40 polyvinyl chloride (pipe)

Table 2-7
Summary of Medium-Specific Samples for each AOC

AOC	Medium	Ra-226	Th-230	Uranium (U) Isotopes			Metals	VOC	SVOC	PAH	PCB	Pest
		Offsite	Offsite	Offsite		Onsite	Offsite	Offsite	Offsite	Offsite	Offsite	Offsite
	Methodology/ Env. Medium	Gamma	Alpha	Alpha	Gamma	Gamma	SW6010; SW7471	SW8260	SW8270	SW8270	SW8082	SW8081
Operable Unit 1												
1	Soil	15	21	U-234 = 35; U-238 = 35: U-235 = 35	U-235 = 97; Th-234 = 97	U-238 = 118; Th-234 = 7	18	17	17	10	17	7
	Groundwater - Aquifer A	40	18	U-234 = 39; U-238 = 39; U-235 = 39	0	0	39	6	0	0	0	0
	Groundwater - Aquifer B	73	32	U-234 = 73; U-238 = 73; U-235 = 73	0	0	69	16	12	0	8	8
2	Soil	24	20	U-234 = 15; U-238 = 15: U-235 = 15	U-235 = 136; Th-234 = 136	U-238 = 181; Th-234 = 1	15	15	15	10	15	5
	Groundwater - Aquifer A	44	20	U-234 = 44; U-238 = 44; U-235 = 44	0	0	42	7	0	0	0	0
	Groundwater - Aquifer B	73	32	U-234 = 73; U-238 = 73; U-235 = 73	0	0	69	16	12	0	8	8
	Groundwater - Aquifer C	5	3	U-234 = 5; U-238 = 5; U-235 = 5	0	0	5	0	0	0	0	0

Table 2-7
Summary of Medium-Specific Samples for each AOC (cont.)

AOC	Medium	Ra-226	Th-230	Uranium (U) Isotopes			Metals	VOC	SVOC	PAH	PCB	Pest
		Offsite	Offsite	Offsite		Onsite	Offsite	Offsite	Offsite	Offsite	Offsite	Offsite
	Methodology/ Env. Medium	Gamma	Alpha	Alpha	Gamma	Gamma	SW6010; SW7471	SW8260	SW8270	SW8270	SW8082	SW8081
Operable Unit 2												
3	Soil	71	47	U-234 = 15; U-238 = 15: U-235 = 15	U-235 = 136; Th-234 = 136	U-238 = 181; Th-234 = 1;	20	20	20	20	20	0
	Groundwater - Aquifer B	20	12	U-234 = 20; U-238 = 20: U-235 = 20	0	0	21	10	8	0	0	0
	Surface Water	13	10	U-234 = 14; U-238 = 14: U-235 = 14	0	0	10	10	10	0	0	0
	Sediment	17	20	U-234 = 10; U-238 = 10: U-235 = 10	U-235 = 17	0	10	10	10	10	10	0
5	Soil	22	11	None	U-235 = 22; Th-234 =22	Th-234 = 61	0	0	0	0	0	0
	Groundwater - Aquifer B	3	3	U-234 = 3; U-238 = 3: U-235 = 3	0	0	3	4	3	0	0	0
Operable Unit 3												
4	Soil	50	30	U-234 = 20; U-238 = 20: U-235 = 20	U-235 = 50; Th-234 = 50	0	20	20	20	20	20	0
	Groundwater - Aquifer A	25	23	U-234 = 25; U-238 = 25: U-235 = 25	0	0	27	5	0	0	0	0

Table 2-7
Summary of Medium-Specific Samples for each AOC (cont.)

AOC	Medium	Ra-226	Th-230	Uranium (U) Isotopes			Metals	VOC	SVOC	PAH	PCB	Pest
		Offsite	Offsite	Offsite		Onsite	Offsite	Offsite	Offsite	Offsite	Offsite	Offsite
	Methodology/ Env. Medium	Gamma	Alpha	Alpha	Gamma	Gamma	SW6010; SW7471	SW8260	SW8270	SW8270	SW8082	SW8081
4	Groundwater - Aquifer B	8	8	U-234 = 8; U-238 = 8: U-235 = 8	0	0	8	2	2	0	0	0
6	Soil	91	28	U-234 = 20; U-238 = 20: U-235 = 20	U-235 = 91; Th-234 = 91	0	20	20	20	20	20	0
	Groundwater - Aquifer B	31	28	U-234 = 31; U-238 = 31: U-235 = 31	0	0	29	7	7	0	0	0
	Surface Water	12	12	U-234 = 12; U-238 = 12: U-235 = 12	0	0	10	10	10	0	0	0
	Sediment	13	13	U-234 = 10; U-238 = 10: U-235 = 10	U-235 = 13; Th-234 = 13	0	10	10	10	10	10	0

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
AOC 1 - Building 845 Area												
1BH001-BS-015-0									√			√
1BH001-BS-050-0			√				√		√		√	√
1BH001-BS-125-0									√			√
1BH001-SS-000-0			√				√		√		√	√
1BH002-BS-050-0			√				√		√		√	√
1BH002-BS-080-0		√										
1BH002-BS-125-0									√			√
1BH002-SS-000-0			√				√		√		√	√
1BH003-BS-025-0									√			√
1BH003-BS-050-0			√				√		√		√	√
1BH003-BS-090-0									√			√
1BH003-SS-000-0			√				√		√		√	√
1BH004-BS-080-0			√				√		√		√	√
1BH004-BS-130-0									√			√
1BH004-SS-000-0			√				√		√		√	√
1BH005-BS-040-0			√		√	√	√	√	√		√	√
1BH005-CC-000-0			√		√	√	√	√			√	
1BH006-BS-015-0									√			√
1BH006-BS-055-0			√				√		√		√	√
1BH006-BS-085-0		√										
1BH006-BS-135-0									√			√
1BH006-SS-000-0			√				√		√		√	√
1-BH-007-02		√										
1-BH-007-02 (0'-2')				√								√
1-BH-007-04		√										
1-BH-007-04 (2'-4')				√								√
1BH007-BS-040-0			√				√		√		√	√
1BH007-BS-135-0									√			√
1BH007-SS-000-0			√				√		√		√	√
1BH008-BS-010-0			√		√	√	√	√	√		√	√
1BH008-BS-065-0									√			√
1BH008-CC-000-0			√		√	√	√	√			√	
1BH009-BS-000-0			√		√	√	√	√	√		√	√
1BH009-BS-020-0			√		√	√	√	√	√		√	√
1BH009-BS-040-0									√			√
1BH009-CC-000-0			√		√	√	√	√			√	
1BH010-BS-000-0			√		√	√	√	√	√		√	√
1BH010-BS-020-0			√		√	√	√	√	√		√	√
1BH010-CC-000-0			√		√	√	√	√			√	
1BH011-BS-015-0									√			√
1BH011-BS-050-0			√				√		√		√	√
1BH011-SS-000-0			√				√		√		√	√
1BH012-BS-050-0			√				√		√		√	√
1BH012-BS-130-0									√			√
1BH012-SS-000-0			√				√		√		√	√
1BH013-BS-025-0			√				√		√		√	√
1BH013-BS-060-0			√				√		√		√	√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
1BH013-BS-100-0									√			√
1BH013-BS-140-0									√			√
1BH014-BS-040-0			√		√	√	√	√	√		√	√
1BH014-BS-060-0									√			√
1BH014-BS-110-0									√			√
1BH014-SS-000-0			√		√	√	√	√	√		√	√
1BH015-BS-000-0			√		√	√	√	√	√		√	√
1BH015-BS-040-0									√			√
1BH015-BS-060-0									√			√
1BH015-CC-000-0			√		√	√	√	√			√	
1BH016-BS-015-0									√			√
1BH016-BS-050-0			√				√		√		√	√
1BH016-BS-080-0		√										
1BH016-BS-135-0									√			√
1BH016-SS-000-0			√				√		√		√	√
1BH017-BS-050-0			√				√		√		√	√
1BH017-BS-125-0									√			√
1BH017-SS-000-0			√				√		√		√	√
1-BH-018-02		√										
1-BH-018-02 (0'-2')				√								√
1-BH-018-04		√										
1-BH-018-04 (2'-4')				√								√
1BH018-BS-055-0			√				√		√		√	√
1BH018-BS-135-0									√			√
1BH018-SS-000-0			√				√		√		√	√
1BH019-BS-035-0		√										
1BH019-BS-050-0			√				√		√		√	√
1BH019-BS-135-0									√			√
1BH019-SS-000-0			√				√		√		√	√
1BH020-BS-065-0			√				√		√		√	√
1BH020-BS-135-0									√			√
1BH020-SS-000-0			√				√		√		√	√
1BH021-BS-085-0			√				√		√		√	√
1BH021-BS-125-0									√			√
1BH021-SS-000-0			√				√		√		√	√
1BH022-BS-000-0			√		√	√	√	√	√		√	√
1BH022-CC-000-0			√		√	√	√	√			√	
1BH023-BS-015-0									√			√
1BH023-BS-050-0			√				√		√		√	√
1BH023-BS-135-0									√			√
1BH023-SS-000-0			√				√		√		√	√
1BH024-BS-050-0			√				√		√		√	√
1BH024-BS-135-0									√			√
1BH024-SS-000-0			√				√		√		√	√
1BH025-BS-050-0			√				√		√		√	√
1BH025-BS-135-0									√			√
1BH025-SS-000-0			√				√		√		√	√
1BH026-BS-015-0									√			√
1BH026-BS-050-0			√				√		√		√	√
1BH026-BS-130-0									√			√
1BH026-SS-000-0									√			√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
1BH026-SS-000-5			√				√				√	
1BH027-BS-015-0									√			√
1BH027-BS-050-0			√				√		√		√	√
1BH027-BS-075-0									√			√
1BH027-SS-000-0			√				√		√		√	√
1BH028-BS-015-0									√			√
1BH028-BS-050-0			√				√		√		√	√
1BH028-BS-125-0									√			√
1BH028-SS-000-0			√				√		√		√	√
1BH029-BS-050-0			√				√		√		√	√
1BH029-SS-000-0			√				√		√		√	√
1BH033-BS-020-0			√		√	√	√	√	√		√	√
1BH033-BS-050-0									√			√
1BH033-BS-075-0									√			√
1BH033-CC-000-0			√		√	√	√	√			√	
1BH034-BS-015-0			√		√	√	√	√	√		√	√
1BH034-BS-025-0									√			√
1BH034-BS-050-0			√				√		√		√	√
1BH034-BS-125-0		√										
1BH034-BS-135-0									√			√
1BH034-SS-000-0			√		√	√	√	√	√		√	√
1BH035-BS-015-0									√			√
1BH035-BS-050-0			√				√		√		√	√
1BH035-BS-135-0									√			√
1BH035-SS-000-0			√				√		√		√	√
1BH036-BS-005-0		√										
1BH036-BS-005-0-1			√		√	√	√	√	√		√	√
1BH036-BS-005-0-2			√		√	√	√	√	√		√	√
1BH036-BS-005-0-3									√			√
1CPT-06-B-P-1	√		√				√				√	
1-MW-07-B-P-01			√				√				√	
1-MW-07-B-P-02			√				√				√	
1-MW-08-B-P-01			2				2				2	
1-MW-17-B-P-01			√				√				√	
1-MW-17-B-P-02			√				√				√	
1-MW-21-B-P-01	√		√				√				√	
1-MW-21-B-P-02	√		√				√				√	
1-MW-22-B-P-01	√		√				√				√	
1-MW-22-B-P-02	√		√				√				√	
1-SB-01-BS-P-02	√	√	√		√	√	√	√		√		
1-SB-01-SS-P-00	√	√	√		√	√	√	√		√		
1-SB-02-BS-P-01	√	√	√		√	√	√	√		√		
1-SB-02-SS-P-00	√	√	√		√	√	√	√		√		
1-SB-03-BS-P-04	√	√	√		√	√	√	√		√		
1-SB-03-SS-P-00	√	√	√		√	√	√	√		√		
1-SB-04-BS-P-01	√	√	√		√	√	√	√		√		
1-SB-04-SS-P-00	√	√	√		√	√	√	√		√		
1-SB-05-BS-P-03	√	√	√		√	√	√	√		√		
1-SB-05-SS-P-00	√	√	√		√	√	√	√		√		
1TP001-BS-015-0									√			√
1TP004-BS-015-0									√			√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
1TP007-BS-015-0			√		√	√	√	√	√		√	√
1TP013-BS-010-0									√			√
1TP014-BS-015-0									√			√
1TP015-BS-015-0									√			√
1TP017-BS-010-0									√			√
1TP018-BS-015-0									√			√
1TP022-BS-010-0			√		√	√	√	√	√		√	√
1TP023-BS-010-0									√			√
1TP024-BS-005-0									√			√
1TP024-BS-020-0			√				√		√		√	√
1TP025-BS-065-0-1									√			√
1TP025-CC-050-0-1			√				√				√	
1TP025-CC-050-0-2			√		√	√	√	√			√	
1TP025-CC-050-0-3			√				√				√	
Elevator Shaft (0'-2')				√								√
Elevator Shaft (0-2)		√										
AOC 2 - F Corral												
2BH001-BS-005-0			√				√		√		√	√
2BH001-BS-050-0			√				√		√		√	√
2BH001-BS-120-0									√			√
2BH002-BS-005-0			√				√		√		√	√
2BH002-BS-050-0			√				√		√		√	√
2BH002-BS-125-0									√			√
2BH003-BS-015-0									√			√
2BH003-BS-050-0			√				√		√		√	√
2BH003-BS-120-0									√			√
2BH003-SS-000-0			√				√		√		√	√
2BH004-BS-050-0			√				√		√		√	√
2BH004-BS-085-0		√										
2BH004-BS-135-0									√			√
2BH004-SS-000-0			√				√		√		√	√
2BH005-BS-005-0			√				√		√		√	√
2BH005-BS-020-0									√			√
2BH005-BS-050-0			√				√		√		√	√
2BH005-BS-125-0									√			√
2BH006-BS-005-0			√				√		√		√	√
2BH006-BS-020-0									√			√
2BH006-BS-050-0		√										
2BH006-BS-070-0			√				√		√		√	√
2BH006-BS-125-0									√			√
2BH007-BS-005-0			√				√		√		√	√
2BH007-BS-020-0									√			√
2BH007-BS-050-0			√				√		√		√	√
2BH007-BS-125-0									√			√
2BH008-BS-005-0			√				√		√		√	√
2BH008-BS-030-0									√			√
2BH008-BS-050-0			√				√		√		√	√
2BH008-BS-135-0									√			√
2BH009-BS-005-0			√				√		√		√	√
2BH009-BS-020-0									√			√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
2BH009-BS-030-0		√										
2BH009-BS-050-0			√				√		√		√	√
2BH009-BS-125-0									√			√
2BH010-BS-005-0			√				√		√		√	√
2BH010-BS-020-0									√			√
2BH010-BS-050-0			√				√		√		√	√
2BH010-BS-080-0									√			√
2BH010-BS-125-0									√			√
2BH011-BS-015-0									√			√
2BH011-BS-050-0			√				√		√		√	√
2BH011-BS-130-0									√			√
2BH011-SS-000-0			√				√		√		√	√
2BH012-BS-005-0			√				√		√		√	√
2BH012-BS-020-0									√			√
2BH012-BS-050-0			√				√		√		√	√
2BH012-BS-110-0		√										
2BH012-BS-125-0									√			√
2BH013-BS-005-R			√				√		√		√	√
2BH013-BS-020-R									√			√
2BH013-BS-050-R			√				√		√		√	√
2BH013-BS-135-R									√			√
2BH014-BS-005-0									√			√
2BH014-BS-005-R			√				√		√		√	√
2BH014-BS-020-0									√			√
2BH014-BS-020-R									√			√
2BH014-BS-050-0			√				√		√		√	√
2BH014-BS-135-0									√			√
2BH015-BS-005-0									√			√
2BH015-BS-005-R			√				√		√		√	√
2BH015-BS-020-0									√			√
2BH015-BS-020-R									√			√
2BH015-BS-040-R									√			√
2BH015-BS-050-0									√			√
2BH015-BS-080-R			√				√		√		√	√
2BH015-BS-100-R									√			√
2BH015-CC-065-R			√				√				√	
2BH016-BS-005-0			√				√		√		√	√
2BH016-BS-020-0									√			√
2BH016-BS-050-0			√				√		√		√	√
2BH016-BS-120-0									√			√
2BH017-BS-005-0			√				√		√		√	√
2BH017-BS-020-0									√			√
2BH017-BS-050-0			√				√		√		√	√
2BH017-BS-120-0									√			√
2BH018 (0-2)		√										
2-BH-018 (500ML)		√										
2-BH-018-02 (0'-2')				√								√
2BH018-BS-005-0			√				√		√		√	√
2BH018-BS-020-0									√			√
2BH018-BS-025-0			√		√	√	√	√			√	
2BH018-BS-030-0									√			√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
2BH018-BS-050-R			√		√	√	√	√	√		√	√
2BH018-BS-065-R									√			√
2BH018-BS-125-R									√			√
2BH019-BS-005-0			√				√		√		√	√
2BH019-BS-020-0									√			√
2BH019-BS-060-R			√				√		√		√	√
2BH019-BS-140-R									√			√
2BH020-BS-015-0									√			√
2BH020-BS-050-0			√				√		√		√	√
2BH020-BS-125-0									√			√
2BH020-SS-000-0			√				√		√		√	√
2BH021-BS-010-R			√				√		√		√	√
2BH021-BS-025-R									√			√
2BH021-BS-050-R			√				√		√		√	√
2BH021-BS-125-R									√			√
2BH022-BS-005-0			√				√		√		√	√
2BH022-BS-020-0									√			√
2BH022-BS-050-0			√				√		√		√	√
2BH022-BS-135-0									√			√
2BH023-BS-005-0									√			√
2BH023-BS-020-0									√			√
2BH023-BS-020-R			√				√		√		√	√
2BH023-BS-040-R			√				√		√		√	√
2BH023-BS-100-R									√			√
2BH023-BS-120-R									√			√
2BH024-BS-005-0			√				√		√		√	√
2BH024-BS-020-0									√			√
2BH024-BS-050-0			√				√		√		√	√
2BH024-CC-060-0			√				√				√	
2-BH-025-02		√										
2-BH-025-02 (0'-2')				√								√
2-BH-025-04		√										
2-BH-025-04 (2'-4')				√								√
2BH025-BS-005-0			√				√		√		√	√
2BH025-BS-020-0									√			√
2BH025-BS-050-0			√				√		√		√	√
2BH025-BS-135-0									√			√
2BH026-BS-005-0			√				√		√		√	√
2BH026-BS-020-0			√				√		√		√	√
2BH026-BS-040-0			√				√		√		√	√
2BH026-BS-150-0									√			√
2BH027-BS-005-0			√				√		√		√	√
2BH027-BS-005-R			√				√		√		√	√
2BH027-BS-020-0			√				√		√		√	√
2BH027-BS-025-R									√			√
2BH027-BS-045-R			√				√		√		√	√
2BH027-BS-090-R									√			√
2BH027-BS-145-R									√			√
2BH028-BS-005-0			√				√		√		√	√
2BH028-BS-020-0									√			√
2BH028-BS-050-0			√				√		√		√	√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
2BH028-BS-135-0									√			√
2BH029-BS-005-R			√				√		√		√	√
2BH029-BS-020-R									√			√
2BH029-BS-050-R			√				√		√		√	√
2BH029-BS-130-R									√			√
2BH030-BS-005-0			√				√		√		√	√
2BH030-BS-020-0									√			√
2BH030-BS-050-0			√				√		√		√	√
2BH030-BS-130-0									√			√
2BH031-BS-005-0			√				√		√		√	√
2BH031-BS-005-R			√				√		√		√	√
2BH031-BS-020-0									√			√
2BH031-BS-050-R									√			√
2BH031-BS-090-R			√				√		√		√	√
2BH031-BS-140-R									√			√
2BH032-BS-005-0			√				√		√		√	√
2BH032-BS-030-0									√			√
2BH032-BS-052-0									√			√
2BH032-BS-080-0			√				√		√		√	√
2BH032-BS-100-0									√			√
2BH032-CC-070-0			√				√				√	
2BH032-CC-075-0			√				√				√	
2BH033-BS-005-0			√				√		√		√	√
2BH033-BS-050-0			√				√		√		√	√
2BH033-BS-095-0									√			√
2BH033-BS-130-0									√			√
2BH034-BS-005-0			√				√		√		√	√
2BH034-BS-020-0									√			√
2BH034-BS-050-0			√				√		√		√	√
2BH034-BS-075-0		√										
2BH034-BS-120-0									√			√
2BH035-BS-005-R			√				√		√		√	√
2BH035-BS-020-R									√			√
2BH035-BS-055-R			√				√		√		√	√
2BH035-BS-135-R									√			√
2BH036-BS-005-R			√				√		√		√	√
2BH036-BS-020-R									√			√
2BH036-BS-050-R			√				√		√		√	√
2BH036-BS-135-R									√			√
2BH037-BS-005-0			√				√		√		√	√
2BH037-BS-020-0									√			√
2BH037-BS-050-0			√				√		√		√	√
2BH037-BS-120-0		√										
2BH037-BS-135-0									√			√
2BH038-BS-005-0			√				√		√		√	√
2BH038-BS-020-0			√		√	√	√	√	√		√	√
2BH038-BS-020-R			√		√	√	√	√	√		√	√
2BH039-BS-005-0			√				√		√		√	√
2BH039-BS-020-0									√			√
2BH039-BS-050-0			√				√		√		√	√
2BH039-BS-135-0									√			√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
2BH040-BS-015-0									√			√
2BH040-BS-050-0			√				√		√		√	√
2BH040-BS-130-0									√			√
2BH040-SS-000-0			√				√		√		√	√
2BH041-BS-015-0									√			√
2BH041-BS-050-0			√				√		√		√	√
2BH041-BS-135-0									√			√
2BH041-SS-000-0			√				√		√		√	√
2BH042-BS-050-0			√				√		√		√	√
2BH042-BS-085-0									√			√
2BH042-BS-135-0									√			√
2BH042-SS-000-0			√				√		√		√	√
2BH043-SS-000-0			√		√	√	√	√	√		√	√
2-MW-01-B-P-01			√				√				√	
2-MW-01-B-P-02			√				√				√	
2-MW-01-B-P-03			√				√				√	
2-MW-02-B-P-01			√				√				√	
2-MW-02-B-P-02			√				√				√	
2-MW-03-B-P-01			√				√				√	
2-MW-03-B-P-02			√				√				√	
2-MW-03-B-P-03			√				√				√	
2-MW-04-B-P-01			√				√				√	
2-MW-04-B-P-02			√				√				√	
2-MW-05-B-P-01			√				√				√	
2-MW-05-B-P-02			√				√				√	
2-MW-06-B-P-01			√				√				√	
2-MW-12-B-P-01			√				√				√	
2-MW-12-B-P-02			√				√				√	
2-MW-15-B-P-01			√				√				√	
2-MW-16-B-P-01			√				√				√	
2-MW-16-B-P-02			√				√				√	
2-MW-19-B-P-01	√		√				√				√	
2-MW-19-B-P-02	√		√				√				√	
2-MW-20-B-P-01	√		√				√				√	
2-MW-20-B-P-02	√		√				√				√	
2-MW-23-B-P-01	√		√				√				√	
2-MW-23-B-P-02	√		√				√				√	
2-MW-24-B-P-01	√		√				√				√	
2-MW-24-B-P-02	√		√				√				√	
2-MW-25-B-P-05	√		√				√				√	
2-MW-25-B-P-18	√		√				√				√	
2-MW-25-B-P-24	√		√				√				√	
2-MW-25-B-P-31	√		√				√				√	
2-MW-26-B-P-01	√		√				√				√	
2-MW-26-B-P-02	√		√				√				√	
2-SB-06-BS-P-02	√	√	√		√	√	√	√		√		
2-SB-06-SS-P-00	√	√	√		√	√	√	√		√		
2-SB-07-BS-P-01	√	√	√		√	√	√	√		√		
2-SB-07-SS-P-00	√	√	√		√	√	√	√		√		
2-SB-08-BS-P-01	√	√	√		√	√	√	√		√		
2-SB-08-SS-P-00	√	√	√		√	√	√	√		√		

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
2-SB-09-BS-P-01	√	√	√		√	√	√	√		√		
2-SB-09-SS-P-00	√	√	√		√	√	√	√		√		
2-SB-10-BS-P-02	√	√	√		√	√	√	√		√		
2-SB-10-SS-P-00	√	√	√		√	√	√	√		√		
AOC 3 - Central Drainage Ditch												
3-MW-13-B-P-01			√				√				√	
3-MW-13-B-P-02			√				√				√	
3-MW-14-B-P-01			√				√				√	
3-MW-14-B-P-02			√				√				√	
3-SB-01-B-0-02	√		√				√				√	
3-SB-01-B-0-02 (2'-4')				√								√
3-SB-01-B-0-03 (4'-6')				√								√
3-SB-01-B-0-04 (6'-8')				√								√
3-SB-01-B-0-05	√		√				√				√	
3-SB-01-B-0-05 (8'-10')				√								√
3-SB-02-B-0-02		√										
3-SB-02-B-0-02 (2'-4')				2								2
3-SB-02-B-0-03 (4'-6')				√								√
3-SB-02-B-0-04 (6'-8')				√								√
3-SB-02-B-0-05	√		√				√				√	
3-SB-02-B-0-05 (8'-10')				√								√
3-SB-03-B-0-02		√										
3-SB-03-B-0-02 (2'-4')				√								√
3-SB-03-B-0-03 (4'-6')				√								√
3-SB-03-B-0-04 (6'-8')				√								√
3-SB-03-B-0-05	√		√				√				√	
3-SB-03-B-0-05 (8'-10')				√								√
3-SB-04-B-0-02		√										
3-SB-04-B-0-02 (2'-4')				√								√
3-SB-04-B-0-03 (4'-6')				√								√
3-SB-04-B-0-04 (6'-8')				√								√
3-SB-04-B-0-05	√		√				√				√	
3-SB-04-B-0-05 (8'-10')				√								√
3-SB-05-B-0-02	√		√				√				√	
3-SB-05-B-0-02 (2'-4')				√								√
3-SB-05-B-0-03 (4'-6')				√								√
3-SB-05-B-0-04 (6'-8')				√								√
3-SB-05-B-0-05	√		√				√				√	
3-SB-05-B-0-05 (8'-10')				√								√
3-SB-06-B-0-02	√		√				√				√	
3-SB-06-B-0-03 (4'-6')				√								√
3-SB-06-B-0-04 (6'-8')				√								√
3-SB-06-B-0-05	√		√				√				√	
3-SB-06-B-0-05 (8'-10')				√								√
3-SB-07-B-0-02 (2'-4')				√								√
3-SB-07-B-0-03	√		√				√				√	
3-SB-07-B-0-03 (4'-6')				√								√
3-SB-07-B-0-04 (6'-8')				√								√
3-SB-07-B-0-05	√		√				√				√	
3-SB-07-B-0-05 (8'-10')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
3-SB-07-B-0-06 (6'-8')				√								√
3-SB-08-B-0-01		√										
3-SB-08-B-0-01 (0'-2')				√								√
3-SB-08-B-0-02 (2'-4')				√								√
3-SB-08-B-0-03	√		√				√				√	
3-SB-08-B-0-03 (4'-6')				√								√
3-SB-08-B-0-04 (4'-6')				√								√
3-SB-08-B-0-05	√		√				√				√	
3-SB-08-B-0-05 (8'-10')				√								√
3-SB-09-B-0-01	√		√				√				√	
3-SB-09-B-0-01 (0'-2')				√								√
3-SB-09-B-0-02		√										
3-SB-09-B-0-02 (2'-4')				√								√
3-SB-09-B-0-03 (4'-6')				√								√
3-SB-09-B-0-04 (6'-8')				√								√
3-SB-09-B-0-05	√		√				√				√	
3-SB-09-B-0-05 (8'-10')				√								√
3-SB-10-B-0-01		√										
3-SB-10-B-0-01 (0'-2')				√								√
3-SB-10-B-0-02	√		√				√				√	
3-SB-10-B-0-02 (2'-4')				√								√
3-SB-10-B-0-03 (4'-6')				√								√
3-SB-10-B-0-04 (6'-8')				√								√
3-SB-10-B-0-05	√		√				√				√	
3-SB-10-B-0-05 (8'-10')				√								√
3-SB-11-B-0-02		√										
3-SB-11-B-0-02 (2'-4')				√								√
3-SB-11-B-0-03 (4'-6')				√								√
3-SB-11-B-0-04	√		√				√				√	
3-SB-11-B-0-04 (6'-8')				√								√
3-SB-11-B-0-05	√		√				√				√	
3-SB-11-B-0-05 (8'-10')				√								√
3-SB-12-B-0-02	√		√				√				√	
3-SB-12-B-0-02 (2'-4')				√								√
3-SB-12-B-0-03 (4'-6')				√								√
3-SB-12-B-0-04 (6'-8')				√								√
3-SB-12-B-0-05	√		√				√				√	
3-SB-12-B-0-05 (8'-10')				√								√
3-SB-13-B-0-02 (2'-4')				√								√
3-SB-13-B-0-03 (4'-6')				√								√
3-SB-13-B-0-04	√		√				√				√	
3-SB-13-B-0-04 (6'-8')				√								√
3-SB-13-B-0-05	√		√				√				√	
3-SB-13-B-0-05 (8'-10')				√								√
3-SB-14-B-0-02 (2'-4')				√								√
3-SB-14-B-0-03	√		√				√				√	
3-SB-14-B-0-03 (4'-6')				√								√
3-SB-14-B-0-04 (6'-8')				√								√
3-SB-14-B-0-05	√		√				√				√	
3-SB-14-B-0-05 (8'-10')				√								√
3-SB-15-B-0-02 (2'-4')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
3-SB-15-B-0-03 (4'-6')				√								√
3-SB-15-B-0-04	√		√				√				√	
3-SB-15-B-0-04 (6'-8')				√								√
3-SB-15-B-0-05	√		√				√				√	
3-SB-15-B-0-05 (8'-10')				√								√
3-SB-15-B-1-02 (2'-4')				√								√
3-SB-15-B-1-03 (4'-6')				√								√
3-SB-15-B-1-04 (6'-8')				√								√
3-SB-15-B-1-05 (8'-10')				√								√
3-SB-16-B-0-03 (4'-6')				√								√
3-SB-16-B-0-04	√		√				√				√	
3-SB-16-B-0-04 (6'-8')				√								√
3-SB-16-B-0-05	√		√				√				√	
3-SB-16-B-0-05 (8'-10')				√								√
3-SB-17-B-0-02		√										
3-SB-17-B-0-02 (2'-4')				√								√
3-SB-17-B-0-03	√		√				√				√	
3-SB-17-B-0-03 (4'-6')				√								√
3-SB-17-B-0-04 (6'-8')				√								√
3-SB-17-B-0-05	√		√				√				√	
3-SB-17-B-0-05 (8'-10')				√								√
3-SB-18-B-0-02	√		√				√				√	
3-SB-18-B-0-02 (2'-4')				√								√
3-SB-18-B-0-03		√										
3-SB-18-B-0-03 (4'-6')				√								√
3-SB-18-B-0-04 (6'-8')				√								√
3-SB-18-B-0-05	√		√				√				√	
3-SB-18-B-0-05 (8'-10)				√								√
3-SB-19-B-0-02 (2'-4)				√								√
3-SB-19-B-0-03	√		√				√				√	
3-SB-19-B-0-03 (4'-6)				√								√
3-SB-19-B-0-04 (6'-8)				√								√
3-SB-19-B-0-05	√		√				√				√	
3-SB-19-B-0-05 (8'-10)				√								√
3-SB-19-B-1-03 (5'-7)				√								√
3-SB-20-B-0-01		√										
3-SB-20-B-0-01 (0'-2')				√								√
3-SB-20-B-0-02 (2'-4')				√								√
3-SB-20-B-0-03 (4'-6')				√								√
3-SB-20-B-0-04	√		√				√				√	
3-SB-20-B-0-04 (6'-8')				√								√
3-SB-20-B-0-05	√		√				√				√	
3-SB-20-B-0-05 (8'-10')				√								√
3-SB-21-B-0-01 (0'-2')				√								√
3-SB-21-B-0-02		√										
3-SB-21-B-0-02 (2'-4')				√								√
3-SB-21-B-0-03	√		√				√				√	
3-SB-21-B-0-03 (4'-6')				√								√
3-SB-21-B-0-04 (6'-8')				√								√
3-SB-21-B-0-05	√		√				√				√	
3-SB-21-B-0-05 (8'-10')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
3-SB-22-B-0-01	√		√				√				√	
3-SB-22-B-0-01 (0'-2')				√								√
3-SB-22-B-0-02		√										
3-SB-22-B-0-02 (2'-4')				√								√
3-SB-22-B-0-03 (4'-6')				√								√
3-SB-22-B-0-04 (6'-8')				√								√
3-SB-22-B-0-05	√		√				√				√	
3-SB-22-B-0-05 (8'-10')				√								√
3-SB-23-B-0-01	√		√				√				√	
3-SB-23-B-0-01 (0'-2')				√								√
3-SB-23-B-0-02		√										
3-SB-23-B-0-02 (2'-4')				√								√
3-SB-23-B-0-03 (4'-6')				√								√
3-SB-23-B-0-04 (6'-8')				√								√
3-SB-23-B-0-05	√		√				√				√	
3-SB-23-B-0-05 (8'-10')				√								√
3-SB-24-B-0-01 (0'-2')				√								√
3-SB-24-B-0-02	√		√				√				√	
3-SB-24-B-0-02 (2'-4')				√								√
3-SB-24-B-0-03		√										
3-SB-24-B-0-03 (4'-6')				√								√
3-SB-24-B-0-04 (6'-8')				√								√
3-SB-24-B-0-05	√		√				√				√	
3-SB-24-B-0-05 (8'-10')				√								√
3-SB-24-B-1-01 (0'-2')				√								√
3-SB-24-B-1-02 (2'-4')				√								√
3-SB-24-B-1-03 (4'-6')				√								√
3-SB-24-B-1-04 (6'-8')				√								√
3-SB-24-B-1-05 (8'-10')				√								√
3-SB-25-B-0-01 (0'-2')				√								√
3-SB-25-B-0-02	√		√				√				√	
3-SB-25-B-0-02 (2'-4')				√								√
3-SB-25-B-0-03		√										
3-SB-25-B-0-03 (4'-6')				√								√
3-SB-25-B-0-04 (6'-8')				√								√
3-SB-25-B-0-05	√		√				√				√	
3-SB-25-B-0-05 (8'-10')				√								√
3-SB-26-B-0-01 (0'-2')				√								√
3-SB-26-B-0-02		√										
3-SB-26-B-0-02 (2'-4')				√								√
3-SB-26-B-0-03 (4'-6')				√								√
3-SB-26-B-0-04	√		√				√				√	
3-SB-26-B-0-04 (6'-8')				√								√
3-SB-26-B-0-05	√		√				√				√	
3-SB-26-B-0-05 (8'-10')				√								√
3-SB-26-B-1-01 (0'-2')				√								√
3-SB-26-B-1-02 (2'-4')				√								√
3-SB-26-B-1-03 (4'-6')				√								√
3-SB-26-B-1-04 (6'-8')				√								√
3-SB-26-B-1-05 (8'-10')				√								√
3-SB-27-B-0-01 (0'-2')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
3-SB-27-B-0-02	√		√				√				√	
3-SB-27-B-0-02 (2'-4')				√								√
3-SB-27-B-0-03		√										
3-SB-27-B-0-03 (4'-6')				√								√
3-SB-27-B-0-04 (6'-8')				√								√
3-SB-27-B-0-05	√		√				√				√	
3-SB-27-B-0-05 (8'-10')				√								√
3-SB-27-B-0-06 (10'-12')				√								√
3-SB-27-B-0-07 (12'-14')				√								√
3-SB-27-B-0-08 (20'-22')				√								√
3-SB-27-B-1-07 (12'-14')				√								√
3-SB-30-BS-P-05	√	√	√		√	√	√	√		√		
3-SB-30-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-31-BS-P-05	√	√	√		√	√	√	√		√		
3-SB-31-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-32-BS-P-04	√	√	√		√	√	√	√		√		
3-SB-32-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-33-BS-P-01	√	√	√		√	√	√	√		√		
3-SB-33-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-34-BS-P-04	√	√	√		√	√	√	√		√		
3-SB-34-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-35-BS-P-04	√	√	√		√	√	√	√		√		
3-SB-35-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-36-BS-P-05	√	√	√		√	√	√	√		√		
3-SB-36-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-37-BS-P-06	√	√	√		√	√	√	√		√		
3-SB-37-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-38-BS-P-07	√	√	√		√	√	√	√		√		
3-SB-38-SS-P-00	√	√	√		√	√	√	√		√		
3-SB-39-BS-P-04	√	√	√		√	√	√	√		√		
3-SB-39-SS-P-00	√	√	√		√	√	√	√		√		
3-SS-28-R-0-01 (0-6)				√								√
AOC 4 - Historical Lagoon A												
4CPT-12-B-P-14	√		√				√				√	
4CPT-16-B-P-12.5	√		√				√				√	
4CPT-22-B-P-6.5	√		√				√				√	
4CPT-33-B-P-5	√		√				√				√	
4-MW-01-B-P-17	√	√	√				√				√	
4-MW-01-B-P-18	√	√	√				√				√	
4-MW-02-B-P-09	√	√	√				√				√	
4-MW-02-B-P-10	√	√	√				√				√	
4-MW-05-B-P-03	√	√	√				√				√	
4-MW-05-B-P-09	√	√	√				√				√	
4-MW-06-B-P-01	√	√	√				√				√	
4-MW-06-B-P-08	√	√	√				√				√	
4-MW-07-B-P-07	√	√	√				√				√	
4-MW-07-B-P-09	√	√	√				√				√	
4-SB-23-B-P-09	√		√				√				√	
4-SB-23-B-P-10	√		√				√				√	
4-SB-24-B-P-09	√		√				√				√	

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
4-SB-24-B-P-10	√		√				√				√	
4-SB-25-B-P-03	√		√				√				√	
4-SB-25-B-P-05	√		√				√				√	
4-SB-26-B-P-02	√		√				√				√	
4-SB-26-B-P-08	√		√				√				√	
4-SB-27-B-P-06	√		√				√				√	
4-SB-27-B-P-09	√		√				√				√	
4-SB-28-B-P-07	√		√				√				√	
4-SB-28-B-P-10	√		√				√				√	
4-SB-29-B-P-07	√		√				√				√	
4-SB-29-B-P-11	√		√				√				√	
4-SB-30-B-P-04	√		√				√				√	
4-SB-30-B-P-08	√		√				√				√	
4-SB-31-BS-P-05	√	√	√		√	√	√	√		√		
4-SB-31-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-32-BS-P-01	√	√	√		√	√	√	√		√		
4-SB-32-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-33-BS-P-05	√	√	√		√	√	√	√		√		
4-SB-33-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-34-BS-P-07	√	√	√		√	√	√	√		√		
4-SB-34-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-35-BS-P-02	√	√	√		√	√	√	√		√		
4-SB-35-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-36-BS-P-03	√	√	√		√	√	√	√		√		
4-SB-36-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-37-BS-P-04	√	√	√		√	√	√	√		√		
4-SB-37-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-38-BS-P-02	√	√	√		√	√	√	√		√		
4-SB-38-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-39-BS-P-01	√	√	√		√	√	√	√		√		
4-SB-39-SS-P-00	√	√	√		√	√	√	√		√		
4-SB-40-BS-P-06	√	√	√		√	√	√	√		√		
4-SB-40-SS-P-00	√	√	√		√	√	√	√		√		
AOC 5 - Building J-26 Area												
5-SB-03-B-0-01		√										
5-SB-03-B-0-01 (0'-2')				√								√
5-SB-03-B-0-02	√		√				√				√	
5-SB-03-B-0-02 (2'-4')				√								√
5-SB-03-B-0-03 (4'-6')				√								√
5-SB-03-B-0-04 (6'-8')				√								√
5-SB-03-B-0-05	√		√				√				√	
5-SB-03-B-0-05 (8'-10')				√								√
5-SB-04-B-0-01	√		√				√				√	
5-SB-04-B-0-01 (0'-2')				√								√
5-SB-04-B-0-02		√										
5-SB-04-B-0-02 (2'-4')				√								√
5-SB-04-B-0-03 (4'-6')				√								√
5-SB-04-B-0-04 (6'-8')				√								√
5-SB-04-B-0-05	√		√				√				√	
5-SB-04-B-0-05 (8'-10')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
5-SB-05-B-0-01		√										
5-SB-05-B-0-01 (0'-2')				√								√
5-SB-05-B-0-02	√		√				√				√	
5-SB-05-B-0-02 (2'-4')				√								√
5-SB-05-B-0-03 (4'-6')				√								√
5-SB-05-B-0-04 (6'-8')				√								√
5-SB-05-B-0-05	√		√				√				√	
5-SB-05-B-0-05 (8'-10')				√								√
5-SB-06-B-0-02	√		√				√				√	
5-SB-06-B-0-02 (2'-4')				√								√
5-SB-06-B-0-03 (4'-6')				√								√
5-SB-06-B-0-04		√										
5-SB-06-B-0-04 (6'-8')				√								√
5-SB-06-B-0-05	√		√				√				√	
5-SB-06-B-0-05 (8'-10')				√								√
5-SB-07-B-0-01		√										
5-SB-07-B-0-01(0'-2')				√								√
5-SB-07-B-0-02(2'-4')				√								√
5-SB-07-B-0-03	√		√				√				√	
5-SB-07-B-0-03 (4'-6')				√								√
5-SB-07-B-0-04 (6'-8')				√								√
5-SB-07-B-0-05	√		√				√				√	
5-SB-07-B-0-05 (8'-10')				√								√
5-SB-08-B-0-01 (0'-2')				√								√
5-SB-08-B-0-02		√										
5-SB-08-B-0-02 (2'-4')				√								√
5-SB-08-B-0-03	√		√				√				√	
5-SB-08-B-0-03 (4'-6')				√								√
5-SB-08-B-0-04	√		√				√				√	
5-SB-08-B-0-04 (6'-8')				√								√
5-SB-08-B-0-05 (8'-10')				√								√
5-SB-09-B-0-01(0'-2')				√								√
5-SB-09-B-0-02		√										
5-SB-09-B-0-02(2'-4')				√								√
5-SB-09-B-0-03	√		√				√				√	
5-SB-09-B-0-03(4'-6')				√								√
5-SB-09-B-0-04(6'-8')				√								√
5-SB-09-B-0-05	√		√				√				√	
5-SB-09-B-0-05(8'-10')				√								√
5-SB-09-B-1-01(0'-2')				√								√
5-SB-09-B-1-05(8'-10')				√								√
5-SB-10-B-0-01	√		√				√				√	
5-SB-10-B-0-01 (0'-2')				√								√
5-SB-10-B-0-02		√										
5-SB-10-B-0-02 (2'-4')				√								√
5-SB-10-B-0-03 (4'-6')				√								√
5-SB-10-B-0-04 (6'-8')				√								√
5-SB-10-B-0-05	√		√				√				√	
5-SB-10-B-0-05 (8'-10')				√								√
5-SB-10-B-1-01 (0'-2')				√								√
5-SB-10-B-1-02 (2'-4')				√								√

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
5-SB-10-B-1-03 (4'-6')				√								√
5-SB-10-B-1-04 (6'-8')				√								√
5-SB-10-B-1-05 (8'-10')				√								√
5-SB-11-B-0-01 (0'-2')				√								√
5-SB-11-B-0-02	√		√				√				√	
5-SB-11-B-0-02 (2'-4')				√								√
5-SB-11-B-0-03		√										
5-SB-11-B-0-03 (4'-6')				√								√
5-SB-11-B-0-04 (6'-8')				√								√
5-SB-11-B-0-05	√		√				√				√	
5-SB-11-B-0-05 (8'-10')				√								√
5-SB-13-B-0-01 (0'-2')				√								√
5-SB-13-B-0-02		√										
5-SB-13-B-0-02 (2'-4')				√								√
5-SB-13-B-0-03 (4'-6')				√								√
5-SB-13-B-0-04	√		√				√				√	
5-SB-13-B-0-04 (6'-8')				√								√
5-SB-13-B-0-05	√		√				√				√	
5-SB-13-B-0-05 (8'-10')				√								√
5-SB-15-B-0-01 (0'-2')				√								√
5-SB-15-B-0-02	√		√				√				√	
5-SB-15-B-0-02 (2'-4')				√								√
5-SB-15-B-0-03		√										
5-SB-15-B-0-03 (4'-6')				√								√
5-SB-15-B-0-04 (6'-8')				√								√
5-SB-15-B-0-05	√		√				√				√	
5-SB-15-B-0-05 (8'-10')				√								√
AOC 6 - East Area												
6CPT-05-B-P-8.5	√		√				√				√	
6CPT-21-B-P-2	√		√				√				√	
6CPT-25-B-P-5	√		√				√				√	
6CPT-37-B-P-8	√		√				√				√	
6CPT-45-B-P-2.5	√		√				√				√	
6CPT-54-B-P-11	√		√				√				√	
6CPT-62A-B-P-0.5	√		√				√				√	
6-MW-01-B-P-07	√		√				√				√	
6-MW-01-B-P-19	√		√				√				√	
6-MW-02-B-P-08	√		√				√				√	
6-MW-02-B-P-18	√		√				√				√	
6-MW-03-B-P-07	√		√				√				√	
6-MW-03-B-P-17	√		√				√				√	
6-MW-04-B-P-07	√	√	√				√				√	
6-MW-04-B-P-13	√	√	√				√				√	
6-MW-05-B-P-08	√	√	√				√				√	
6-MW-05-B-P-12	√	√	√				√				√	
6-MW-06-B-P-18	√	√	√				√				√	
6-MW-06-B-P-19	√	√	√				√				√	
6-MW-07-B-P-17	√	√	√				√				√	
6-MW-07-B-P-25	√	√	√				√				√	
6-SB-01-B-P-08	√		√				√				√	

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
6-SB-01-B-P-10	√		√				√				√	
6-SB-02-B-P-02	√		√				√				√	
6-SB-02-B-P-11	√		√				√				√	
6-SB-03-B-P-03	√		√				√				√	
6-SB-03-B-P-06	√		√				√				√	
6-SB-04-B-P-01	√		√				√				√	
6-SB-04-B-P-06	√		√				√				√	
6-SB-05-B-P-02	√		√				√				√	
6-SB-05-B-P-08	√		√				√				√	
6-SB-06-B-P-02	√		√				√				√	
6-SB-06-B-P-10	√		√				√				√	
6-SB-07-B-P-02	√		√				√				√	
6-SB-07-B-P-09	√		√				√				√	
6-SB-08-B-P-02	√		√				√				√	
6-SB-08-B-P-10	√		√				√				√	
6-SB-09-B-P-04	√		√				√				√	
6-SB-09-B-P-10	√		√				√				√	
6-SB-10-B-P-01	√		√				√				√	
6-SB-10-B-P-10	√		√				√				√	
6-SB-11-B-P-01	√		√				√				√	
6-SB-11-B-P-10	√		√				√				√	
6-SB-12-B-P-00	√		√				√				√	
6-SB-12-B-P-06	√		√				√				√	
6-SB-13-B-P-06	√		√				√				√	
6-SB-13-B-P-10	√		√				√				√	
6-SB-14-B-P-06	√		√				√				√	
6-SB-14-B-P-10	√		√				√				√	
6-SB-15-B-P-06	√		√				√				√	
6-SB-15-B-P-11	√		√				√				√	
6-SB-16-B-P-07	√		√				√				√	
6-SB-16-B-P-11	√		√				√				√	
6-SB-17A-B-P-04	√		√				√				√	
6-SB-17A-B-P-11	√		√				√				√	
6-SB-17-B-P-02	√		√				√				√	
6-SB-17-B-P-05	√		√				√				√	
6-SB-18A-B-P-06	√		√				√				√	
6-SB-18A-B-P-11	√		√				√				√	
6-SB-18-B-P-03	√		√				√				√	
6-SB-18-B-P-05	√		√				√				√	
6-SB-19-B-P-06	√		√				√				√	
6-SB-19-B-P-11	√		√				√				√	
6-SB-20-B-P-06	√		√				√				√	
6-SB-20-B-P-11	√		√				√				√	
6-SB-21-B-P-05	√		√				√				√	
6-SB-21-B-P-11	√		√				√				√	
6-SB-22-B-P-05	√		√				√				√	
6-SB-22-B-P-10	√		√				√				√	
6-SB-31-B-P-03	√		√				√				√	
6-SB-31-B-P-10	√		√				√				√	
6-SB-32-BS-P-04	√	√	√		√	√	√	√		√		
6-SB-32-SS-P-00	√	√	√		√	√	√	√		√		

Table 2-8
Summary of Radiological Analyses Performed at Each Sample Location (cont.)

Sample ID	RA-226	Th-230	Th-234		U-234	U-235		U-238		Uranium (Total)		
	Offsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma	Offsite Alpha	Offsite Alpha	Offsite Gamma	Offsite Alpha	Onsite Gamma	Offsite Alpha	Offsite Gamma	Onsite Gamma
6-SB-33-BS-P-03	√	√	√		√	√	√	√		√		
6-SB-33-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-34-BS-P-03	√	√	√		√	√	√	√		√		
6-SB-34-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-35-BS-P-03	√	√	√		√	√	√	√		√		
6-SB-35-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-36-BS-P-02	√	√	√		√	√	√	√		√		
6-SB-36-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-37-BS-P-01	√	√	√		√	√	√	√		√		
6-SB-37-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-38-BS-P-01	√	√	√		√	√	√	√		√		
6-SB-38-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-39-BS-P-01	√	√	√		√	√	√	√		√		
6-SB-39-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-40-BS-P-05	√	√	√		√	√	√	√		√		
6-SB-40-SS-P-00	√	√	√		√	√	√	√		√		
6-SB-41-BS-P-05	√	√	√		√	√	√	√		√		
6-SB-41-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-01-BS-P-08	√	√	√		√	√	√	√		√		
7-SB-01-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-02-BS-P-06	√	√	√		√	√	√	√		√		
7-SB-02-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-03-BS-P-05	√	√	√		√	√	√	√		√		
7-SB-03-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-04-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-04-SS-P-04	√	√	√		√	√	√	√		√		
7-SB-05-BS-P-02	√	√	√		√	√	√	√		√		
7-SB-05-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-06-BS-P-04	√	√	√		√	√	√	√		√		
7-SB-06-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-07-BS-P-03	√	√	√		√	√	√	√		√		
7-SB-07-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-08-BS-P-05	√	√	√		√	√	√	√		√		
7-SB-08-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-09-BS-P-03	√	√	√		√	√	√	√		√		
7-SB-09-SS-P-00	√	√	√		√	√	√	√		√		
7-SB-10-BS-P-09	√	√	√		√	√	√	√		√		
7-SB-10-SS-P-00	√	√	√		√	√	√	√		√		

Offsite Gamma Method = 713R9; EPA 901.1; EPA 901.1 mRa; and LANL ER-130Mod
Offsite Alpha Method = 714R10; and EM U-02-Modifi
Onsite Gamma Method = Cabrera OP-029; and OU2 Onsite Gamma Screen

Table 2-9
Summary of Other Chemical Analyses Performed at Specific Sample Locations

Sample ID	GenChem	MET	PAH	PCB	PEST	RAD	SVOA	TCLP	VOA
AOC 1 - Building 845 Area									
1BH004-BS-050-0		√		√	√		√	√	√
1BH006-BS-065-0	√								
1BH007-BS-055-0		√		√	√		√	√	√
1BH007-BS-120-0	√								
1BH013-BS-050-0		√		√	√		√	√	√
1BH013-BS-060-0						√			
1BH013-BS-090-0	√	√					√		
1BH018-BS-080-0		√		√	√		√	√	√
1BH019-BS-020-0	√								
1BH021-BS-060-0	√								
1BH026-SS-000-0		√		√	√	√	√	√	√
1BH033-BS-020-0		√		√	√	√		√	√
1BH036-BS-005-0	√	√		√	√	√	√	√	√
1-SB-01-BS-P-02		√	√	√		√	√		√
1-SB-01-SS-P-00		√	√	√		√	√		√
1-SB-02-BS-P-01		√	√	√		√	√		√
1-SB-02-SS-P-00		√	√	√		√	√		√
1-SB-03-BS-P-04		√	√	√		√	√		√
1-SB-03-SS-P-00		√	√	√		√	√		√
1-SB-04-BS-P-01		√	√	√		√	√		√
1-SB-04-SS-P-00		√	√	√		√	√		√
1-SB-05-BS-P-03		√	√	√		√	√		√
1-SB-05-SS-P-00		√	√	√		√	√		√
AOC 2 - F Corral									
2BH003-BS-075-0	√								
2BH004-BS-015-0		√		√	√		√	√	√
2BH004-BS-030-0	√								
2BH007-BS-060-0	√								
2BH010-BS-005-R		√		√	√		√	√	√
2BH010-BS-006-R	√								
2BH013-BS-005-0		√		√	√		√	√	√
2BH016-BS-030-0	√								
2BH018-BS-015-R		√		√	√		√	√	√
2BH018-BS-085-R	√								
2BH020-BS-025-0	√								
2BH020-SS-000-0	√	√		√	√	√	√	√	√
2BH034-BS-078-0	√								
2BH038-BS-022-R	√								
2-SB-06-BS-P-02		√	√	√		√	√		√
2-SB-06-SS-P-00		√	√	√		√	√		√
2-SB-07-BS-P-01		√	√	√		√	√		√
2-SB-07-SS-P-00		√	√	√		√	√		√
2-SB-08-BS-P-01		√	√	√		√	√		√
2-SB-08-SS-P-00		√	√	√		√	√		√
2-SB-09-BS-P-01		√	√	√		√	√		√
2-SB-09-SS-P-00		√	√	√		√	√		√

Table 2-9
Summary of Other Chemical Analyses Performed at Specific Sample Locations (cont.)

Sample ID	GenChem	MET	PAH	PCB	PEST	RAD	SVOA	TCLP	VOA
2-SB-10-BS-P-02		√	√	√		√	√		√
2-SB-10-SS-P-00		√	√	√		√	√		√
AOC 3 - Central Drainage Ditch									
3-SB-30-BS-P-05		√	√	√		√	√		√
3-SB-30-SS-P-00		√	√	√		√	√		√
3-SB-31-BS-P-05		√	√	√		√	√		√
3-SB-31-SS-P-00		√	√	√		√	√		√
3-SB-32-BS-P-04		√	√	√		√	√		√
3-SB-32-SS-P-00		√	√	√		√	√		√
3-SB-33-BS-P-01		√	√	√		√	√		√
3-SB-33-SS-P-00		√	√	√		√	√		√
3-SB-34-BS-P-04		√	√	√		√	√		√
3-SB-34-SS-P-00		√	√	√		√	√		√
3-SB-35-BS-P-04		√	√	√		√	√		√
3-SB-35-SS-P-00		√	√	√		√	√		√
3-SB-36-BS-P-05		√	√	√		√	√		√
3-SB-36-SS-P-00		√	√	√		√	√		√
3-SB-37-BS-P-06		√	√	√		√	√		√
3-SB-37-SS-P-00		√	√	√		√	√		√
3-SB-38-BS-P-07		√	√	√		√	√		√
3-SB-38-SS-P-00		√	√	√		√	√		√
3-SB-39-BS-P-04		√	√	√		√	√		√
3-SB-39-SS-P-00		√	√	√		√	√		√
AOC 4 - Historical Lagoon A									
4-SB-31-BS-P-05		√	√	√		√	√		√
4-SB-31-SS-P-00		√	√	√		√	√		√
4-SB-32-BS-P-01		√	√	√		√	√		√
4-SB-32-SS-P-00		√	√	√		√	√		√
4-SB-33-BS-P-05		√	√	√		√	√		√
4-SB-33-SS-P-00		√	√	√		√	√		√
4-SB-34-BS-P-07		√	√	√		√	√		√
4-SB-34-SS-P-00		√	√	√		√	√		√
4-SB-35-BS-P-02		√	√	√		√	√		√
4-SB-35-SS-P-00		√	√	√		√	√		√
4-SB-36-BS-P-03		√	√	√		√	√		√
4-SB-36-SS-P-00		√	√	√		√	√		√
4-SB-37-BS-P-04		√	√	√		√	√		√
4-SB-37-SS-P-00		√	√	√		√	√		√
4-SB-38-BS-P-02		√	√	√		√	√		√
4-SB-38-SS-P-00		√	√	√		√	√		√
4-SB-39-BS-P-01		√	√	√		√	√		√
4-SB-39-SS-P-00		√	√	√		√	√		√
4-SB-40-BS-P-06		√	√	√		√	√		√
4-SB-40-SS-P-00		√	√	√		√	√		√

Table 2-9
Summary of Other Chemical Analyses Performed at Specific Sample Locations (cont.)

Sample ID	GenChem	MET	PAH	PCB	PEST	RAD	SVOA	TCLP	VOA
AOC 6 - East Area									
6-SB-32-BS-P-04		√	√	√		√	√		√
6-SB-32-SS-P-00		√	√	√		√	√		√
6-SB-33-BS-P-03		√	√	√		√	√		√
6-SB-33-SS-P-00		√	√	√		√	√		√
6-SB-34-BS-P-03		√	√	√		√	√		√
6-SB-34-SS-P-00		√	√	√		√	√		√
6-SB-35-BS-P-03		√	√	√		√	√		√
6-SB-35-SS-P-00		√	√	√		√	√		√
6-SB-36-BS-P-02		√	√	√		√	√		√
6-SB-36-SS-P-00		√	√	√		√	√		√
6-SB-37-BS-P-01		√	√	√		√	√		√
6-SB-37-SS-P-00		√	√	√		√	√		√
6-SB-38-BS-P-01		√	√	√		√	√		√
6-SB-38-SS-P-00		√	√	√		√	√		√
6-SB-39-BS-P-01		√	√	√		√	√		√
6-SB-39-SS-P-00		√	√	√		√	√		√
6-SB-40-BS-P-05		√	√	√		√	√		√
6-SB-40-SS-P-00		√	√	√		√	√		√
6-SB-41-BS-P-05		√	√	√		√	√		√
6-SB-41-SS-P-00		√	√	√		√	√		√
Background Reference Area									
7-SB-01-BS-P-08	√	√				√			
7-SB-01-SS-P-00	√	√				√			
7-SB-02-BS-P-06	√	√				√			
7-SB-02-SS-P-00	√	√				√			
7-SB-03-BS-P-05	√	√				√			
7-SB-03-SS-P-00	√	√				√			
7-SB-04-SS-P-00	√	√				√			
7-SB-04-SS-P-04	√	√				√			
7-SB-05-BS-P-02	√	√				√			
7-SB-05-SS-P-00	√	√				√			
7-SB-06-BS-P-04	√	√				√			
7-SB-06-SS-P-00	√	√				√			
7-SB-07-BS-P-03	√	√				√			
7-SB-07-SS-P-00	√	√				√			
7-SB-08-BS-P-05	√	√				√			
7-SB-08-SS-P-00	√	√				√			
7-SB-09-BS-P-03	√	√				√			
7-SB-09-SS-P-00	√	√				√			
7-SB-10-BS-P-09	√	√				√			
7-SB-10-SS-P-00	√	√				√			

Table 2-10
Analytical Methods by Media

Analysis	Extraction Method	Analysis Method
Aqueous Samples		
TCL VOCs	SW3500	SW 8260B
TCL SVOCs	SW3540A	SW 8270C
TAL Metals	SW3050	SW 6010B/7470
Nitrate		EPA 353.3
Sulfate		EPA 300
Sulfide		EPA 300
Chloride		EPA 300
Fluoride		EPA 300
Total Phosphates		EPA 365.3
Alkalinity as CaCO3		EPA 310
Uranium by ICP-MS		EPA 6020
Isotopic U + Th		ASTM 3972-90 modified
Ra-226 & Ra-228		EPA 903/904
Gross Alpha & Gross Beta		EPA 900
Solid Samples		
TCL VOCs	SW5030A	SW 8260B
TCL SVOCs	SW3540A	SW 8270C
SVOCs - SIMS	SW3540A	SW 8270 SIMS
TCL PCBs		SW 8082
TAL Metals	SW3050A	SW 6010B/7470
PCBs	SW3540A	EPA 8082
TOC		Walkley Black
Isotopic U + Th		ASTM 3972-90 modified
Uranium by Gamma Spec		713R9
Ra-226 & 228 (ingrowth)		EPA 901.1m

Table 2-11
Geotechnical Parameters for Soil

Parameter	Method	Number of Samples	Where Analyzed
Grain size	ASTM D422	AOC3: 5; AOC5: 4	Paragon Analytics
Soil moisture content	ASTM D2216	AOC3: 5; AOC5: 4	
Specific gravity	ASTM D854	AOC3: 5; AOC5: 4	
Liquid and plastic limits	ASTM D4318	AOC3: 5; AOC5: 4	
pH	SW 9054C	AOC3: 5; AOC5: 4	
Cation exchange capacity	EPA 9081	AOC3: 4; AOC5: 4	USACE Waterways Experiment Station
			Experiment Station
Total organic carbon	SW 9060	AOC3: 4; AOC5: 4 Background Area: 20	USACE Waterways Experiment Station
K_d	Batch method, (after Langmuir, 1997)	OU1: 4; OU2: 2	
SEM/XRD	Not applicable	AOC3: 2, AOC5: 2	
U availability	Sequential extraction (after Ryan et.al., 2001)	OU1: 4; AOC3: 1; AOC5: 1	

Notes:

ASTM: American Society for Testing and Materials

Kd: distribution coefficient

SEM/XRD: scanning electron microscope/x-ray diffraction

U: Uranium

\ = Background Reference Area

Table 2-12
Water Quality Parameters

Parameters	Analytical Method	No. of Samples
Dissolved Oxygen	EPA 360.1 (probe, using flow-through cell	110
Ferrous Iron (2)	Hach 8146 (Colorimeteric titration, open beaker)	88
Hydrogen Peroxide	Hach HYP-1, Test Strips	
Nitrate	EPA 300	120
Nitrite	Hach 8507 (Colorimeteric titration, open beaker)	59
Oxidation Reduction Potential (ORP)	ASTM D1498 (probe, using flow-through cell)	111
pH	EPA 150.1 (electrometric, using flow-through cell)	111
Specific Conductance	EPA 9095 (probe, using flow-through cell)	111
Sulfide	Hach 8131 (Colorometric titration, open beaker)	59
Temperature	EPA 170.1 (probe, using flow-through cell)	111
Turbidity	EPA 180.1 (Nephlometric, using flow-through cell)	111

Table 2-13
Comparison of Soil Screening Values to Offsite Laboratory MDCs

Radionuclide	NRC Generic Screening Value (pCi/g)	NJDEP Soil Screening Value (pCi/g)	Contractor Off-Site Laboratory Required MDC for Soil (pCi/g)
U-234	13	10	4
U-235	8	7	2
U-238	14	10	4

Notes:

pCi/g = picocuries per gram

MDC = Minimum Detectable Concentration

U=uranium

NRC = Nuclear Regulatory Commission

NJDEP = New Jersey Dept of Environmental Protection

Table 2-14
Comparison of Groundwater Screening Values to Offsite Laboratory MDCs

Radionuclide	EPA Drinking Water Standard	NJ Drinking Water Standard	Contractor Off-Site Laboratory Required MDC for Water
Ra-226 + Ra-228	5 pCi/L (Total)	5 pCi/L (Total)	1 pCi/L
Gross Alpha Activity	15 pCi/L excluding U and Rn, but including Ra-226	15 pCi/L excluding U and Rn, but including Ra-226	3 pCi/L
Total Uranium	30 µg/L	30 µg/L	1 µg/L

Notes:

pCi/L = picocuries per liter

µg/L = micrograms per liter

MDC = Minimum Detectable Concentration

Ra = radium

Rn = radon

EPA - Environmental Protection Agency

NJ = New Jersey

Table 2-15
Sampling Results used to Correlate Offsite and Onsite Gamma Spectroscopy

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth	End Depth	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH001	1BH001-SS-000-0	7/10/02	0	1.5	**19.9**		2.58	2.76	**49.5**		2.75	
1BH002	1BH002-SS-000-0	6/26/02	0	1.5	**111.74**		8.52	4.38	**127**		6.95	
1BH003	1BH003-SS-000-0	7/9/02	0	1.5	**40.74**		3.7	3.27	**32.7**		1.83	
1BH004	1BH004-SS-000-0	6/26/02	0	1.5	8.53		2.03	3.19	13.6		0.83	
1BH005	1BH005-BS-040-0	6/14/02	4	4.5	9.66	J	1.61	2.62	13		0.894	
1BH009	1BH009-BS-000-0	6/18/02	0	1.5	**218.45**	J	16.23	6.47	**579**		31.4	
1BH009	1BH009-BS-020-0	6/18/02	2	3.5	3.36	J	1.29	2.15	1.31	J	0.17	
1BH010	1BH010-BS-000-0	6/17/02	0	0.75	**18.46**	J	1.83	2.07	**23.1**		1.31	
1BH011	1BH011-SS-000-0	7/8/02	0	1.5	3.32		1.17	2.11	6.34		0.45	
1BH012	1BH012-SS-000-0	6/21/02	0	1	4.89	J	0.98	1.37	1.2	J	0.19	
1BH014	1BH014-SS-000-0	6/20/02	0	1.5	**20.99**	J	2.38	2.54	**27**		1.6	
1BH015	1BH015-BS-000-0	6/19/02	0	1.5	5.04	J	1.27	2.02	6.78		0.44	
1BH016	1BH016-SS-000-0	7/1/02	0	1.5	**61.08**		5.62	4.5	**93.7**		5.16	
1BH018	1BH018-SS-000-0	6/25/02	0	1.5	**20.24**	J	2.58	3.41	**21.4**		1.23	
1BH021	1BH021-SS-000-0	6/24/02	0	1.5	3.8	J	1.09	2.49	2.07	J	0.27	
1BH022	1BH022-BS-000-0	6/17/02	0	1	7.33	J	1.39	1.86	5.26		0.39	
1BH024	1BH024-SS-000-0	7/3/02	0	1.5	4.66		0.92	1.76	3.27		0.32	
1BH025	1BH025-SS-000-0	7/3/02	0	1.5	9.86		1.54	2.41	**15.1**		0.88	
1BH027	1BH027-SS-000-0	7/11/02	0	1.5	**85.74**		7.26	5.31	**72**		3.97	
1BH029	1BH029-SS-000-0	7/8/02	0	2	**29.14**		3.25	3.12	**62.3**		3.42	
1BH034	1BH034-SS-000-0	6/26/02	0	1.5	**677.41**		49.8	10.14	**644**		35.1	
1BH034	1BH034-BS-015-0	6/26/02	1.5	3	**40.88**		4.47	2.58	**122**		6.64	
1BH035	1BH035-SS-000-0	7/9/02	0	1.5	**104.38**		8.27	4.59	**90.8**		4.98	
1BH036	1BH036-SS-005-0-1	7/16/02	0	1.5	**99,043**		7,051	474.6	**51,454**		19,107	122.4
1BH036	1BH036-SS-005-0-2	7/16/02	0	1.5	**19,041**		1,388	87.7	**12,256**		4,551	114.6
1TP007	1TP007-BS-015-0	8/23/02	1.5	2	**132.63**		10.36	5.43	**111**		6.12	
1TP022	1TP022-BS-010-0	8/23/02	1	1.5	**432.11**		31.9	8.18	**652**		35.3	
1TP024	1TP024-BS-020-0	8/26/02	2	2.5	13.76		2.24	2.85	9.22		0.601	
2BH004	2BH004-SS-000-0	7/26/02	0	1.5	11.91		2.18	2.57	5.24		0.41	
2BH006	2BH006-BS-070-0	7/22/02	7	8.5	1.91	J	1.46	2.21	2.02	J	0.26	
2BH009	2BH009-BS-005-0	7/26/02	0.5	2	4.71		1.47	2.25	2.28		0.22	
2BH009	2BH009-BS-050-0	7/26/02	5	6.5	1.24	J	1.05	1.86	0.84	J	0.13	
2BH010	2BH010-BS-005-0	7/26/02	0.5	2	**119.4**		9.68	6.17	**159**		8.67	
2BH011	2BH011-SS-000-0	7/11/02	0	1.5	5.42		1.19	1.91	3.69		0.32	
2BH012	2BH012-BS-005-0	8/8/02	0.5	2	3.79		1.23	2.39	1.75	J	0.217	
2BH017	2BH017-BS-005-0	8/2/02	0.5	2	2.51	J	1	2.96	1.81		0.14	
2BH018	2BH018-BS-005-0	7/31/02	0.5	1.75	**21.59**		2.37	2.27	**22.7**		1.3	
2BH018	2BH018-BS-050-R	7/31/02	5	6.5	**632.52**		46.41	11.01	**663**		36	
2BH019	2BH019-BS-005-0	7/19/02	0.5	1.2	2.2	J	1.01	2.97	4.19	J	0.44	
2BH020	2BH020-SS-000-0	7/11/02	0	1.5	**132.07**		10.6	6.42	**104**		5.69	
2BH025	2BH025-BS-005-0	8/2/02	0.5	2	**28.72**		3.39	3.61	7.62		0.51	
2BH025	2BH025-BS-050-0	8/2/02	5	6.5	11.67		1.92	2.77	5.05		0.36	
2BH026	2BH026-BS-005-0	8/16/02	0.5	1.2	8.32		1.39	2.88	5.29		0.37	
2BH026	2BH026-BS-020-0	8/16/02	2	2.7	**19.72**		2.51	3.11	**14.1**		0.85	
2BH026	2BH026-BS-040-0	8/16/02	4	4.5	**23.18**		3.05	3.8	**15.9**		0.96	
2BH027	2BH027-BS-005-R	8/19/02	0.5	1.5	**142.49**		11.17	5.51	**53.7**		2.98	
2BH027	2BH027-BS-005-0	7/31/02	0.5	1.5	**134.95**		10.67	5.51	**74.4**		4.12	
2BH027	2BH027-BS-020-0	7/31/02	1.5	2.75	**108.65**		8.61	4.68	**167**		9.13	
2BH027	2BH027-BS-045-R	8/19/02	4.5	5.7	**16.62**		2.97	4.24	8.93		0.558	

Table 2-15
Sampling Results used to Correlate Offsite and Onsite Gamma Spectroscopy (cont.)

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
2BH030	2BH030-BS-050-0	8/1/02	5	6.5	6.75		1.94	3.14	1.18	J	0.17	
2BH034	2BH034-BS-050-0	8/1/02	5	6.5	4.64	J	1.71	3.15	1.89	J	0.21	
2BH036	2BH036-BS-050-R	8/1/02	5	6.5	9.62		2.18	2.98	3.38		0.26	
2BH037	2BH037-BS-005-0	8/5/02	0.5	2	3.15	J	1.07	3.16	2.23	J	0.25	
2BH037	2BH037-BS-050-0	8/5/02	5	6.5	9.37		1.32	2.45	9.72		0.60	
2BH038	2BH038-BS-005-0	7/31/02	0.5	2	**49.02**		4.51	4.06	**26.1**		1.49	
2BH038	2BH038-BS-020-0	7/31/02	2	3.5	**16584.4**		1197.63	61.19	**10500**		569	
2BH038	2BH038-BS-020-R	8/2/02	2	3.5	**2621.54**		192.86	22.82	**1890**		103	
2BH039	2BH039-BS-005-0	8/6/02	0.5	2	7.83		1.61	2.85	5.89		0.44	
2BH039	2BH039-BS-050-0	8/6/02	5	6.5	5.84		1.51	2.36	2.33		0.25	
2BH042	2BH042-SS-000-0	7/18/02	0	1.5	**263.68**		19.54	8.15	**385**		20.9	
2BH042	2BH042-BS-050-0	7/18/02	5	6.5	3.03	J	1.42	2.17	4.71	J		
2BH043	2BH043-SS-000-0	8/2/02	0	0.5	**237.75**		17.63	6.57	**116**		6.38	
3-SB-05	3-SB-05-B-0-02	8/11/03	2	4	**17.2**		5.7	7.2	**35.3**		13.6	1.84
3-SB-09	3-SB-09-B-0-01 (0'-2')	8/8/03	0	2	**14.7**		4.3	5.1	**15.3**		6.28	1.39
3-SB-17	3-SB-17-B-0-03 (4'-6')	8/22/03	4	6	5.5		2.5	3.5	9.87		4.48	1.53
3-SB-19	3-SB-19-B-0-03 (4'-6)	8/25/03	4	6	**31.5**		6.3	3.9	**39.3**		15.1	1.87
3-SB-20	3-SB-20-B-0-04 (6'-8')	8/22/03	6	8	9.8		3.1	3.3	**37.7**		14.3	1.37
3-SB-25	3-SB-25-B-0-02 (2'-4')	8/26/03	2	4	**30.3**		6.5	4.7	**32.2**		12.3	1.45
3-SB-26	3-SB-26-B-0-04 (6'-8')	8/26/03	6	8	**40.5**		8.8	6.5	**21.9**		8.74	1.77

Correlations: OffResult, OnResult

Pearson correlation of OffResult and OnResult = 0.998

P-Value = 0.000

Table 2-16
Correlation of Isotopic Ratios for Soil and Concrete Samples

Sample ID	Sample Date	Start Depth	End Depth	U-234				U-235				U-238				Isotopic U Ratios	
				Alpha Spec				Alpha Spec				Alpha Spec					
				Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 / U-238	U-235 / U-238
1BH005-CC-000-0	6/14/02	0	0.5	5.34		1.17	0.15	0.16	J	0.13	0.07	5.1		1.13	0.1	1.05	0.03
1BH005-BS-040-0	6/14/02	4	4.5	3.11		0.75	0.11	0.14	J	0.11	0.11	3	J	0.73	0.12	1.04	0.05
1BH008-CC-000-0	6/19/02	0	0.5	1.52		0.45	0.13	0.02	UJ	0.05	0.11	0.93		0.32	0.12	1.63	0.02
1BH008-BS-010-0	6/19/02	1	2.5	0.91		0.31	0.12	0.04	UJ	0.06	0.1	0.64	J	0.25	0.11	1.42	0.06
1BH009-CC-000-0	6/18/02	0	0.5	3.89		1.07	0.23	0.18	J	0.16	0.1	3.55		0.99	0.19	1.10	0.05
1BH009-BS-000-0	6/18/02	0	1.5	125.2	L	25.69	0.67	6.06	J	2.93	0.82	130.7	J	26.71	1.13	0.96	0.05
1BH009-BS-020-0	6/18/02	2	3.5	1.67		0.48	0.14	0.08	UJ	0.09	0.07	1.55	J	0.46	0.06	1.08	0.05
1BH010-CC-000-0	6/17/02	0	0.5	1.39		0.61	0.35	0.1	UJ	0.16	0.26	0.72		0.4	0.12	1.93	0.14
1BH010-BS-000-0	6/17/02	0	0.75	8.17		1.68	0.14	0.54	J	0.25	0.15	7.85	J	1.62	0.12	1.04	0.07
1BH010-BS-020-0	6/17/02	2	3.5	1.11		0.37	0.1	0.04	UJ	0.07	0.14	1	J	0.34	0.11	1.11	0.04
1BH014-SS-000-0	6/20/02	0	1.5	10.04		2.03	0.16	0.27	J	0.18	0.07	10.49	J	2.11	0.1	0.96	0.03
1BH014-BS-040-0	6/20/02	4	5	1.72		0.51	0.2	0.1	UJ	0.11	0.15	1.26	J	0.41	0.18	1.37	0.08
1BH015-CC-000-0	6/19/02	0	0.5	7.42		2.27	0.39	0.34	J	0.32	0.18	7.42		2.27	0.53	1.00	0.05
1BH015-BS-000-0	6/19/02	0	1.5	2.7		0.71	0.11	0.11	UJ	0.11	0.13	3.23	J	0.81	0.14	0.84	0.03
1BH022-CC-000-0	6/17/02	0	0.5	16.83	L	5.09	0.59	0.73	J	0.55	0.52	13.74	L	4.24	0.54	1.22	0.05
1BH022-BS-000-0	6/17/02	0	1	4.32		0.96	0.09	0.14	J	0.12	0.13	3.91	J	0.89	0.11	1.10	0.04
1BH033-CC-000-0	6/30/02	0	0.5	1.84		0.6	0.22	0.06	UJ	0.1	0.16	1.61		0.54	0.13	1.14	0.04
1BH033-BS-020-0	6/30/02	2	3.5	0.87		0.31	0.14	0.02	UJ	0.05	0.07	0.69	J	0.27	0.12	1.26	0.03
1BH034-SS-000-0	6/28/02	0	1.5	347.2		84.86	21.24	21.45	J	16.37	15.19	340.8		83.45	17.6	1.02	0.06
1BH034-BS-015-0	6/28/02	1.5	3	58.62		11.8	1.03	4.51		2.12	1.27	59.39		11.92	1.02	0.99	0.08
1-SB-01-SS-P-00	6/25/07	0	1	4.89	M3	0.91	0.11	0.22		0.11	0.06	4.49		0.84	0.08	1.09	0.05
1-SB-01-BS-P-02	6/25/07	2	3	205	M3	31	0	9.5		1.6	0	203	M3	31	0	1.01	0.05
1-SB-02-SS-P-00	6/26/07	0	1	4.48		0.83	0.08	0.197		0.099	0.052	4.57		0.84	0.07	0.98	0.04
1-SB-02-BS-P-01	6/26/07	1	2	7.8		1.4	0.1	0.47		0.16	0.05	7.4		1.3	0.1	1.05	0.06
1-SB-03-SS-P-00	6/26/07	0	1	6.8		1.2	0.1	0.33		0.13	0.03	7.2		1.3	0	0.94	0.05
1-SB-03-BS-P-04	6/26/07	4	5	2.69		0.54	0.07	0.23		0.11	0.06	2.32		0.48	0.05	1.16	0.10
1-SB-04-SS-P-00	6/26/07	0	1	6.6		1.2	0.1	0.35		0.15	0.08	6.9		1.2	0.1	0.96	0.05
1-SB-04-BS-P-01	6/26/07	1	2	22.3		3.7	0.1	1.08		0.29	0.06	22.6		3.8	0	0.99	0.05
1-SB-05-SS-P-00	6/26/07	0	1	7.9		1.4	0.1	0.42		0.16	0.07	8.3		1.5	0.1	0.95	0.05
1-SB-05-BS-P-03	6/26/07	3	4	263	M3	40	0	12.8	M3	2.1	0.1	266	M3	40	0	0.99	0.05
1TP007-BS-015-0	8/26/03	1.5	2	58.76		16.27	5.66	2.39	UJ	3.16	4.86	53.2		15.16	4.37	1.10	0.04
1TP022-BS-010-0	8/26/03	1	1.5	166.5		42.79	12.37	11.43	J	9.81	9.07	154.2		40.41	9.54	1.08	0.07
1TP025-CC-050-0-2	8/22/03	5	6.5	4.84		2	1.33	0.6	UJ	0.71	0.55	4.9		1.99	1.14	0.99	0.12
2BH018-BS-025-0	7/31/02	2.5	4	2364	L	718.2	39.81	72.49	J	59.79	49.12	2389	L	724.7	39.64	0.99	0.03
2BH018-BS-050-R	7/31/02	5	6.5	263.8		55.67	2.54	12.89		6.4	1.84	282.3		59.19	2.97	0.93	0.05
2BH038-BS-020-0	7/31/02	2	3.5	9459		2526	232.4	503.1		301.9	199.7	9543		2545	220.2	0.99	0.05

Table 2-16
Correlation of Isotopic Ratios for Soil and Concrete Samples (cont.)

Sample ID	Sample Date	Start Depth	End Depth	U-234				U-235				U-238				Isotopic U Ratios	
				Alpha Spec				Alpha Spec				Alpha Spec					
				Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 / U-238	U-235 / U-238
2BH038-BS-020-R	7/31/02	2	3.5	1674		421.8	32.48	78.55		47.66	28.33	1618		408.7	32.34	1.03	0.05
2BH043-SS-000-0	7/18/02	0	0.5	103.5		19.77	0.76	3.1		2.12	0.93	110.5		20.9	1.29	0.94	0.03
2-SB-06-SS-P-00	6/26/07	0	1	2.95		0.58	0.05	0.14		0.081	0.03	3.19		0.62	0.05	0.92	0.04
2-SB-06-BS-P-02	6/26/07	2	3	150		23	0	6.60	M3	1.1	0.1	151		23	0	0.99	0.04
2-SB-07-SS-P-00	6/26/07	0	1	34.1	M3	5.7	0.2	1.64	M3	0.41	0.1	35.3		5.9	0.1	0.97	0.05
2-SB-07-BS-P-01	6/26/07	1	2	385	M3	58	0	17.90	M3	3	0.3	394	M3	59	0	0.98	0.05
2-SB-08-SS-P-00	6/26/07	0	1	1.66		0.38	0.07	0.04	LT	0.05	0.04	1.67		0.38	0.03	0.99	0.02
2-SB-08-BS-P-01	6/26/07	1	2	1.56		0.37	0.07	0.07	LT	0.06	0.06	1.46		0.35	0.05	1.07	0.04
2-SB-09-SS-P-00	6/27/07	0	1	174	M3	29	0	7.8	M3	1.8	0.3	179	M3	30	0	0.97	0.04
2-SB-09-BS-P-01	6/27/07	1	2	123	Y2	22	0	5.6	Y2	1.1	0	128	Y2	23	0	0.96	0.04
2-SB-10-SS-P-00	6/27/07	0	1	20.4		3.4	0.1	1.15		0.26	0.05	20.7		3.4	0.1	0.99	0.06
2-SB-10-BS-P-02	6/27/07	2	3	6500	M3	1200	0	301	M3	76	7	6700	M3	1200	0	0.97	0.04
3-SB-30-SS-P-00	6/27/07	0	1	1.67		0.35	0.06	0.07	LT	0.051	0.055	1.72		0.36	0.06	0.97	0.04
3-SB-30-BS-P-05	6/27/07	5	6	0.87		0.2	0.02	0.045	LT	0.038	0.044	0.92		0.21	0.04	0.95	0.05
3-SB-31-SS-P-00	6/27/07	0	1	10.8		1.9	0.1	0.66		0.18	0.04	11.2		1.9		0.96	0.06
3-SB-31-BS-P-05	6/27/07	5	6	0.56		0.14	0.06	0.028	U	0.029	0.039	0.62		0.15	0.06	0.90	0.05
3-SB-32-SS-P-00	6/27/07	0	1	3.92		0.7	0.04	0.222		0.085	0.035	3.98		0.71	0.04	0.98	0.06
3-SB-32-BS-P-04	6/27/07	4	5	1.44		0.31	0.05	0.088	LT	0.055	0.022	1.19		0.27	0.04	1.21	0.07
3-SB-33-SS-P-00	6/28/07	0	1	1.2		0.26	0.05	0.02	U	0.027	0.039	1.2		0.26	0.04	1.00	0.02
3-SB-33-BS-P-01	6/28/07	1	2	0.38		0.11	0.04	0.034	U	0.034	0.047	0.308		0.097	0.03	1.23	0.11
3-SB-34-SS-P-00	6/28/07	0	1	1.47		0.3	0.05	0.078	LT	0.048	0.035	1.5		0.31	0.03	0.98	0.05
3-SB-34-BS-P-04	6/28/07	4	5	0.97		0.22	0.05	0.064	LT	0.044	0.019	1.02		0.23	0.03	0.95	0.06
3-SB-35-SS-P-00	6/28/07	0	1	0.115		0.054	0.041	0.025	LT	0.025	0.017	0.098	LT	0.052	0.052	1.17	0.26
3-SB-35-BS-P-04	6/28/07	4	5	1.65		0.34	0.04	0.071	LT	0.049	0.021	1.57		0.33	0.04	1.05	0.05
3-SB-36-SS-P-00	6/28/07	0	1	2.03		0.4	0.05	0.125		0.065	0.039	2.21		0.43	0.04	0.92	0.06
3-SB-36-BS-P-05	6/28/07	5	6	10.6		1.8		0.59		0.16	0.04	11		1.9		0.96	0.05
3-SB-37-SS-P-00	6/28/07	0	1	0.38		0.11	0.04	0.049	U	0.04	0.049	0.41		0.12	0.03	0.93	0.12
3-SB-37-BS-P-06	6/28/07	6	7	16.4		2.9	0.1	0.91		0.25	0.06	16.3		2.9		1.01	0.06
3-SB-38-SS-P-00	6/28/07	0	1	0.53		0.15	0.06	0.022	U	0.03	0.043	0.47		0.14	0.06	1.13	0.05
3-SB-38-BS-P-07	6/28/07	7	8	0.269		0.091	0.045	0.005	U	0.024	0.053	0.273		0.091	0.036	0.99	0.02
3-SB-39-SS-P-00	7/5/07	0	1	0.339		0.093	0.034	0.028	U	0.025	0.032	0.299		0.085	0.03	1.13	0.09
3-SB-39-BS-P-04	7/5/07	4	5	169	Y2,M3	29		9.5	Y2,M3	1.9	0.3	178	Y2,M3	31		0.95	0.05

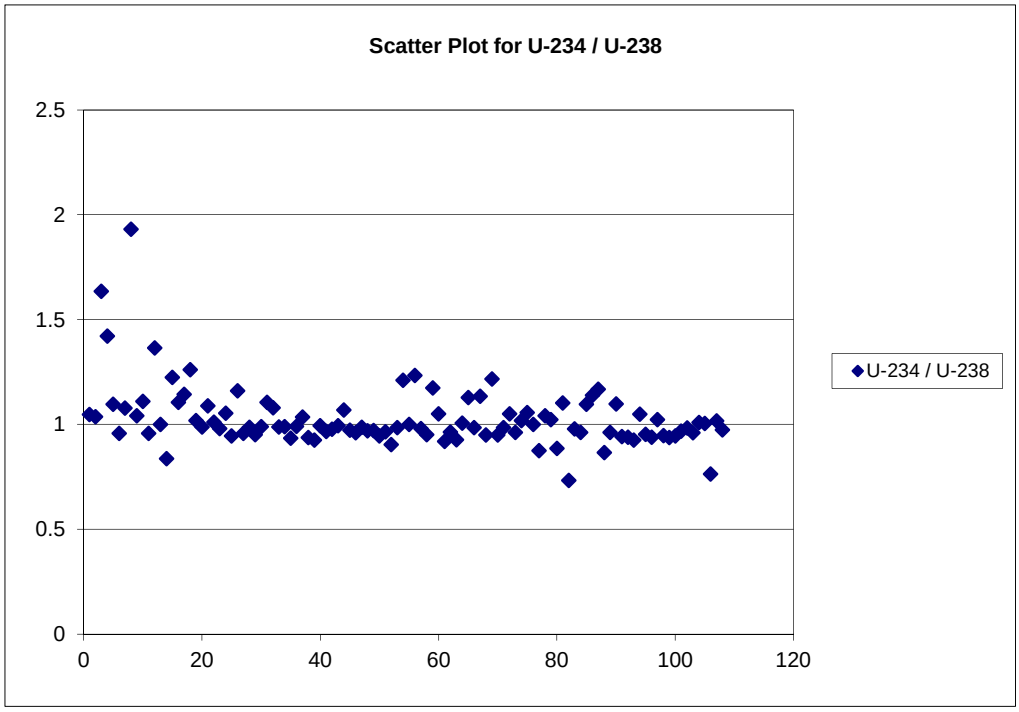
Table 2-16
Correlation of Isotopic Ratios for Soil and Concrete Samples (cont.)

Sample ID	Sample Date	Start Depth	End Depth	U-234				U-235				U-238				Isotopic U Ratios	
				Alpha Spec				Alpha Spec				Alpha Spec					
				Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 / U-238	U-235 / U-238
4-SB-31-SS-P-00	7/3/07	0	1	1.07		0.24	0.03	0.11		0.06	0.03	0.88		0.21	0.03	1.22	0.12
4-SB-31-BS-P-05	7/3/07	5	6	0.22		0.08	0.04	0.01	U	0.02	0.04	0.24		0.08	0.04	0.95	0.04
4-SB-32-SS-P-00	6/29/07	0	1	1.26		0.25	0.02	0.07	LT	0.04	0.01	1.28		0.25	0.03	0.98	0.06
4-SB-32-BS-P-01	6/29/07	1	2	2.54		0.46	0.02	0.09	LT	0.04	0.03	2.42		0.44	0.02	1.05	0.04
4-SB-33-SS-P-00	6/29/07	0	1	1.24		0.24	0.03	0.08	LT	0.04	0.01	1.29		0.25	0.03	0.96	0.06
4-SB-33-BS-P-05	6/29/07	5	6	3.79		0.67	0.03	0.20		0.07	0.02	3.72		0.66	0.01	1.02	0.05
4-SB-34-SS-P-00	6/29/07	0	1	1.12		0.23	0.03	0.09	LT	0.04	0.01	1.06		0.22	0.03	1.06	0.09
4-SB-34-BS-P-07	6/29/07	7	8	23.6		4	0	1.25		0.27	0.03	23.60		4.00	0.00	1.00	0.05
4-SB-35-SS-P-00	6/29/07	0	0	1.6		0.3	0.02	0.08	LT	0.04	0.01	1.83		0.34	0.02	0.87	0.04
4-SB-35-BS-P-02	6/29/07	2	3	0.75		0.16	0.03	0.05	LT	0.03	0.02	0.72		0.16	0.03	1.04	0.07
4-SB-36-SS-P-00	7/3/07	0	1	1.32		0.27	0.03	0.09	LT	0.05	0.03	1.29		0.26	0.04	1.02	0.07
4-SB-36-BS-P-03	7/3/07	3	4	1.24		0.26	0.04	0.15		0.07	0.04	1.40		0.29	0.04	0.89	0.11
4-SB-37-SS-P-00	7/3/07	0	1	0.97		0.21	0.04	0.07	LT	0.04	0.03	0.88		0.19	0.05	1.10	0.08
4-SB-37-BS-P-04	7/3/07	4	5	0.16	Y2	0.08	0.053	0.00	Y2,U	0.04	0.06	0.22	Y2	0.10	0.05	0.73	0.02
4-SB-38-SS-P-00	7/3/07	0	1	2.78		0.5	0.03	0.21		0.08	0.03	2.84		0.51	0.04	0.98	0.08
4-SB-38-BS-P-02	7/3/07	2	3	1.27		0.26	0.03	0.08	LT	0.05	0.03	1.32		0.27	0.03	0.96	0.06
4-SB-39-SS-P-00	7/3/07	0	1	0.57		0.15	0.04	0.06	LT	0.04	0.03	0.52		0.14	0.04	1.10	0.12
4-SB-39-BS-P-01	7/3/07	1	2	0.36		0.11	0.04	0.03	U	0.03	0.04	0.32		0.10	0.04	1.14	0.09
4-SB-40-SS-P-00	7/3/07	0	1	1.25		0.29	0.07	0.04	U	0.04	0.05	1.07		0.26	0.02	1.17	0.04
4-SB-40-BS-P-06	7/3/07	6	7	4.06		0.73	0.04	0.63		0.17	0.03	4.69		0.83	0.03	0.87	0.13
6-SB-32-SS-P-00	7/4/07	0	1	0.76		0.16	0.03	0.06	LT	0.03	0.02	0.79		0.16	0.02	0.96	0.07
6-SB-32-BS-P-04	7/4/07	4	5	0.56		0.12	0.02	0.04	LT	0.03	0.01	0.51		0.12	0.02	1.10	0.07
6-SB-33-SS-P-00	7/4/07	0	1	4.39		0.72	0.02	0.24		0.07	0.02	4.66		0.76	0.02	0.94	0.05
6-SB-33-BS-P-03	7/4/07	3	4	0.61		0.14	0.02	0.04	LT	0.03	0.03	0.65		0.15	0.02	0.94	0.07
6-SB-34-SS-P-00	7/4/07	0	1	15.9		2.5	0	1.21		0.24	0.02	17.2		2.7	0	0.92	0.07
6-SB-34-BS-P-03	7/4/07	3	4	0.65	Y2	0.18	0.04	0.07	Y2,LT	0.05	0.03	0.62	Y2	0.18	0.06	1.05	0.11
6-SB-35-SS-P-00	7/4/07	0	1	26.5		4.2	0.1	1.94		0.39	0.04	27.8		4.4	0.1	0.95	0.07
6-SB-35-BS-P-03	7/4/07	3	4	0.76		0.16	0.01	0.06	LT	0.03	0.02	0.81		0.16	0.02	0.94	0.07
6-SB-36-SS-P-00	7/4/07	0	1	8.8		1.4	0	0.62		0.15	0.03	8.6		1.4	0	1.02	0.07
6-SB-36-BS-P-02	7/4/07	2	3	70	Y2,M3	12	0	5.70	Y2,M3	1.1	0.1	74	Y2	13	0	0.95	0.08
6-SB-37-SS-P-00	7/4/07	0	1	53.2	Y2	9.3	0.1	3.35	Y2	0.69	0.06	56.8	Y2	9.9	0.1	0.94	0.06
6-SB-37-BS-P-01	7/4/07	1	2	57.6	Y2,M3	10	0.1	4.03	Y2	0.83	0.06	61	Y2	11	0	0.94	0.07

Table 2-16
Correlation of Isotopic Ratios for Soil and Concrete Samples (cont.)

Sample ID	Sample Date	Start Depth	End Depth	U-234				U-235				U-238				Isotopic U Ratios	
				Alpha Spec				Alpha Spec				Alpha Spec					
				Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 / U-238	U-235 / U-238
6-SB-38-SS-P-00	7/4/07	0	1	1770	Y2,M3	340	0	105	Y2,M3	23	1	1830	Y2,M3	350	0	0.97	0.06
6-SB-38-BS-P-01	7/4/07	1	2	360	Y2,M3	63	1	20	Y2,M3	5	0.9	366	Y2,M3	64	1	0.98	0.05
6-SB-39-SS-P-00	7/4/07	0	1	5.25		0.88	0.03	0.30		0.09	0.03	5.47		0.91	0.02	0.96	0.05
6-SB-39-BS-P-01	7/4/07	1	2	2.39		0.43	0.03	0.14		0.06	0.03	2.37		0.43	0.01	1.01	0.06
6-SB-40-SS-P-00	7/4/07	0	1	2.53		0.46	0.03	0.19		0.07	0.02	2.52		0.46	0.03	1.00	0.08
6-SB-40-BS-P-05	7/4/07	5	6	0.55		0.15	0.06	0.09	LT	0.05	0.04	0.72		0.18	0.07	0.76	0.12
6-SB-41-SS-P-00	7/4/07	0	1	1.81		0.36	0.03	0.21		0.08	0.02	1.78		0.36	0.04	1.02	0.12
6-SB-41-BS-P-05	7/4/07	5	6	1.88		0.37	0.05	0.15		0.07	0.04	1.93		0.37	0.01	0.97	0.08
															# of Samples	**108**	**108**
															Average	**1.03**	**0.06**
															Maximum	**1.93**	**0.26**
															Minimum	**0.73**	**0.02**
															Std Deviation	**0.15**	**0.032**
															Distribution	**X**	**X**
															UCL-95	**1.05**	**0.068**

Table 2-16 (cont.)
Scatter Plots of Isotopics U Ratios



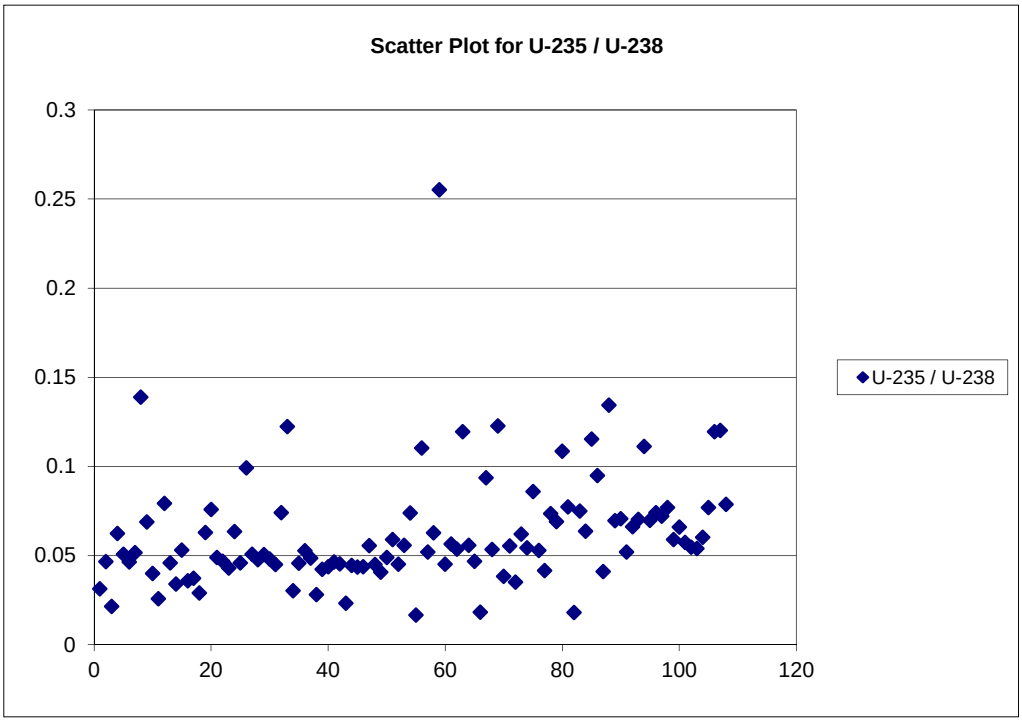


Table 3-1

New Castle County Airport
Wilmington, DE
Climatological Values

Month	Avg. Min Temp. (°F)	Avg. Max Temp. (°F)	Mean Temp. (°F)	Avg. Precip. (inches)	Avg. Wind Direction	Avg. Windspeed (mph)
January	23	39	32	3.1	WNW	13
February	25	42	34	3.0	NW	13
March	33	51	42	3.6	NW	14
April	42	63	53	3.3	NW	13
May	52	73	63	3.8	S	10
June	61	81	72	3.5	S	9
July	67	86	76	4.3	S	9
August	65	84	75	3.8	S	9
September	58	77	68	3.5	NW	8
October	46	67	57	2.9	NW	9
November	37	55	46	3.4	NW	12
December	27	44	36	3.4	NW	12
Yearly	45	64	54	3.5*	NW	11

Average Yearly Precipitation: 41.5 inches.

Summarized from National Weather Service Data for a 42-year period from 1948-1990.

* Average of the monthly precipitation for the year.

Table 3-2
Summary of Hydrostratigraphy at DuPont Chambers Works

Unit	Geologic Age	Thickness (ft)	Depositional Environment	Geologic Description	Hydrogeologic Characteristics
A	Holocene	0-17	Fill	Sand and gravel to clay and rubble	Aquifer. Laterally and vertically heterogeneous. Perched in some places.
A-B	Holocene	0-12	Marsh	Organic silt, clay and peat	Confining Unit. Not continuous due to breaching by recent streams and on-site excavations.
B	Holocene	1-30	Unknown	Interbedded clays, silts, and sands	Aquifer. More permeable than A Aquifer but less permeable than C and D Aquifers.
B-C	Holocene	0-25	Unknown	Gray to black silt or clay	Confining Unit. Thin to absent or sandy in the eastern portion of the site and in the vicinity of the basins, but well developed along Delaware River.
C	Pleistocene	1-35	Probably channel fill	Coarse sand with some cobbles	Aquifer. Significantly more permeable than B Aquifer. Similar to D Aquifer.
C-D	Pleistocene	1-35	Probably interglacial estuarine	Gray or black clay to clayey silt	Confining Unit. Continuous across site.
D	Pleistocene	5-35	Probably channel fill	Poorly sorted, coarse-grained sand with some cobbles	Aquifer. Deposits filled paleovalley that was cut into Cretaceous-age sediments.
D-E	Cretaceous	10-50	Terrestrial	Red clay or variegated (red, white, yellow, and gray) clay	Confining Unit. Regionally effective aquitard.
E	Cretaceous	Unknown	Fluvial	Several fining upward sequences of sands, silts, and clays	Aquifer of Potomac Group.

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Table 4-1
Rationale for Monitoring Well Locations

Well	Aquifer	AOC	Northing	Easting	Rationale for Placement
2-MW-01	B	2	315154	209290	Down-gradient of dissolved U source area
2-MW-02	A	2	315103	209264	Dissolved U source zone
2-MW-03	B	2	315097	209271	Dissolved U source zone
2-MW-04	B	2	315080	209218	Up-gradient of U source zone
2-MW-05	B	2	315066	209284	Up-gradient of U source zone
1-MW-06	A	1	315017	209427	Monitor effect of CDD on A aquifer
1-MW-07	B	1	315015	209420	Monitor effect of CDD on B aquifer
1-MW-08	A	1	314941	209546	Uranium oxide area' [potential] source zone
1-MW-09	B	1	314932	209554	Uranium oxide area' [potential] source zone
1-MW-10	A	1	314888	209471	Elevator Shaft area' [potential] source zone
1-MW-11	B	1	314881	209475	Elevator Shaft area' [potential] source zone
2-MW-12	A	2	315099	209333	Helps make a triangle of wells in 'A' to evaluate flow direction
3-MW-13	B	3	315365	209711	There were elevated unfiltered results at 3SB14
3-MW-14	B	3	315316	209727	There were elevated unfiltered results at 3SB14
2-MW-15	A	2	315166	209276	Helps make a triangle of wells in 'A' to evaluate flow direction
2-MW-16	B	2	315107	208911	Location of elevated U in groundwater to the west.
1-MW-17	B	1	314785	209245	Up-gradient 'control' well
1-MW-18	A	1	314776	209252	Up-gradient 'control' well
2-MW-19	A	2	315188	209323	Confirm extent of dissolved U
2-MW-20	A	2	315131	209382	Confirm extent of dissolved U
1-MW-21	A	1	314728	209256	Confirm extent of dissolved U
1-MW-22	A	1	314772	209336	Confirm extent of dissolved U
2-MW-23	B	2	315149	209361	Confirm downgradient extent of dissolved U
2-MW-24	A	2	314865	209144	Confirm extent of dissolved U
2-MW-25	C	2	315103	209301	Evaluate potential U impact to C Aquifer
2-MW-26	A	2	314994	209177	Confirm extent of dissolved U

Table 4-2
Total Uranium Results for Soil and Concrete Samples, AOC 1

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH001	1BH001-SS-000-0	7/10/02	0	1.5	**19.9**		2.58	2.76	**49.5**		2.75	
	1BH001-BS-015-0	7/10/02	1.5	3					3.04	U		
	1BH001-BS-050-0	7/10/02	5	6.5	4.32	J	1.75	3.09	2.23	U		
	1BH001-BS-125-0	7/10/02	12.5	14					3.43	U		
1BH002	1BH002-SS-000-0	6/26/02	0	1.5	**111.74**		8.52	4.38	**127**		6.95	
	1BH002-BS-050-0	6/26/02	5	6.5	-0.1	U	0.97	2.8	1.6	J	0.19	
	1BH002-BS-125-0	6/26/02	12.5	14					5.45	U		
1BH003	1BH003-SS-000-0	7/9/02	0	1.5	**40.74**		3.7	3.27	**32.7**		1.83	
	1BH003-BS-025-0	7/9/02	2.5	3.5					2.57	U		
	1BH003-BS-050-0	7/9/02	5	6.5	2.24	J	1.25	2.42	0.812	U		
	1BH003-BS-090-0	7/9/02	9	10					6.26	U		
1BH004	1BH004-SS-000-0	6/26/02	0	1.5	8.53		2.03	3.19	13.6		0.83	
	1BH004-BS-080-0	6/26/02	8	9.5	4.54	J	1.92	3.23	4.24	U		
	1BH004-BS-130-0	6/26/02	13	14.5					1.23	U		
1BH005	1BH005-CC-000-0	6/13/02	0	0.5	3.08	J	1.6	2.41				
	1BH005-BS-040-0	6/14/02	4	4.5	9.66	J	1.61	2.62	13		0.894	
1BH006	1BH006-SS-000-0	6/14/02	0	1.5	0.18	U	1.8	2.74	2.72	U		
	1BH006-BS-015-0	6/14/02	1.5	3					3.51	U		
	1BH006-BS-055-0	6/14/02	5.5	6.5	6.81		1.85	2.68	3.56	U		
	1BH006-BS-135-0	6/14/02	13.5	15					0.47	U		
1BH007	1BH007-SS-000-0	6/25/02	0	1.5	0.76	UJ	0.95	1.73	-0.86	U		
	1-BH-007-02 (0'-2')	8/15/03	0	2					2.01		1.57	0.86
	1-BH-007-04 (2'-4')	8/15/03	2	4					2.16	U		1.31
	1BH007-BS-040-0	6/25/02	4	5	1.32	J	1.21	2.42	0.60	U		
	1BH007-BS-135-0	6/25/02	13.5	15					3.69	U		
1BH008	1BH008-CC-000-0	6/14/02	0	0.5	0.63	UJ	0.84	1.44				
	1BH008-BS-010-0	6/19/02	1	2.5	1.99	J	1.2	2.03	0.84	U		
	1BH008-BS-065-0	6/19/02	6.5	8					8.41	U		
1BH009	1BH009-CC-000-0	6/17/02	0	0.5	5.66		1.08	1.46				
	1BH009-BS-000-0	6/18/02	0	1.5	**218.45**	J	16.23	6.47	**579**		31.4	
	1BH009-BS-020-0	6/18/02	2	3.5	3.36	J	1.29	2.15	1.31	J	0.17	
	1BH009-BS-040-0	6/18/02	4	5.5					1.94	J	0.21	
1BH010	1BH010-CC-000-0	6/13/02	0	0.5	-0.37	U	0.8	2.28				
	1BH010-BS-000-0	6/17/02	0	0.75	**18.46**	J	1.83	2.07	**23.1**		1.31	
	1BH010-BS-020-0	6/17/02	2	3.5	2.44	J	1.03	1.71	2.75	U		
1BH011	1BH011-SS-000-0	7/8/02	0	1.5	3.32		1.17	2.11	6.34		0.45	
	1BH011-BS-015-0	7/8/02	1.5	3					2.28	J	0.24	
	1BH011-BS-050-0	7/8/02	5	6.5	1.19	J	0.81	1.5	1.73	U		
1BH012	1BH012-SS-000-0	6/21/02	0	1	4.89	J	0.98	1.37	1.2	J	0.19	
	1BH012-BS-050-0	6/21/02	5	6	0.75	J	0.71	1.22	2.33	U		
	1BH012-BS-130-0	6/21/02	13	14					0.76	U		
1BH013	1BH013-BS-025-0	6/21/02	2.5	4	0.53	UJ	0.75	1.51	3.22	U		
	1BH013-BS-060-0	6/21/02	6	8	1.81	J	1.04	2.28	5.53	U		
	1BH013-BS-100-0	6/21/02	10	11.5					4.82	U		
	1BH013-BS-140-0	6/21/02	14	15					4.37	U		
1BH014	1BH014-SS-000-0	6/20/02	0	1.5	**20.99**	J	2.38	2.54	**27**		1.6	

Table 4-2
Total Uranium Results for Soil and Concrete Samples, AOC 1
(cont.)

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH014	1BH014-BS-040-0	6/20/02	4	5	1.5	J	1.11	1.87	4.84	U		
	1BH014-BS-060-0	6/20/02	6	7					2.04	U		
	1BH014-BS-110-0	6/20/02	11	12					4.63	U		
1BH015	1BH015-CC-000-0	6/14/02	0	0.5	7.04		1.2	1.44				
	1BH015-BS-000-0	6/19/02	0	1.5	5.04	J	1.27	2.02	6.78		0.44	
	1BH015-BS-040-0	6/19/02	4	5.5					1.81	U		
	1BH015-BS-060-0	6/19/02	6	7					5.63	U		
1BH016	1BH016-SS-000-0	7/1/02	0	1.5	**61.08**		5.62	4.5	**93.7**		5.16	
	1BH016-BS-015-0	7/1/02	1.5	2.3					4.11	U		
	1BH016-BS-050-0	7/1/02	5	7	-0.4	U	1.17	3.12	-0.94	U		
	1BH016-BS-135-0	7/1/02	13.5	15					2.33	U		
1BH017	1BH017-SS-000-0	7/2/02	0	2	0.72	UJ	0.78	1.15	0.84	U		
	1BH017-BS-050-0	7/2/02	5	6.5	1.23	J	0.98	1.73	1.26	U		
	1BH017-BS-125-0	7/2/02	12.5	14.5					5.81	U		
1BH018	1BH018-SS-000-0	6/25/02	0	1.5	**20.24**	J	2.58	3.41	**21.4**		1.23	
	1-BH-018-02 (0'-2')	8/15/03	0	2					**149**		55.8	3.87
	1-BH-018-04 (2'-4')	8/15/03	2	4					4.84	U		1.22
	1BH018-BS-055-0	6/25/02	5.5	7	0.16	UJ	1.02	2.97	1.91	U		
	1BH018-BS-135-0	6/25/02	13.5	15					0.24	U		
1BH019	1BH019-SS-000-0	6/25/02	0	1.5	2.81	J	1.46	2.54	2.41	U		
	1BH019-BS-050-0	6/25/02	5	6	4.82	J	1.87	2.92	4.24	U		
	1BH019-BS-135-0	6/25/02	13.5	15					4.03	U		
1BH020	1BH020-SS-000-0	6/24/02	0	1.5	0.89	UJ	1.06	3.08	0.42	U		
	1BH020-BS-065-0	6/24/02	6.5	8	0.73	UJ	1.28	1.87	3.82	U		
	1BH020-BS-135-0	6/24/02	13.5	15					1.7	U		
1BH021	1BH021-SS-000-0	6/24/02	0	1.5	3.8	J	1.09	2.49	2.07	J	0.27	
	1BH021-BS-085-0	6/24/02	8.5	10	1.59	J	0.87	1.49	2.83	U		
	1BH021-BS-125-0	6/24/02	12.5	14					1.78	U		
1BH022	1BH022-CC-000-0	6/14/02	0	0.5	**27.78**	4	2.95	2.72				
	1BH022-BS-000-0	6/17/02	0	1	7.33	J	1.39	1.86	5.26		0.39	
1BH023	1BH023-SS-000-0	7/1/02	0	1.5	3.89		1.21	1.82	5.03	U		
	1BH023-BS-015-0	7/1/02	1.5	2.7					7.65		0.53	
	1BH023-BS-050-0	7/1/02	5	7	1.85	J	1.07	1.78	3.54	U		
	1BH023-BS-135-0	7/1/02	13.5	15					0.84	U		
1BH024	1BH024-SS-000-0	7/3/02	0	1.5	4.66		0.92	1.76	3.27		0.32	
	1BH024-BS-050-0	7/3/02	5	7	0.62	U	1.03	3.01	0.89	J	0.17	
	1BH024-BS-135-0	7/3/02	13.5	15					-1.62	U		
1BH025	1BH025-SS-000-0	7/3/02	0	1.5	9.86		1.54	2.41	**15.1**		0.88	
	1BH025-BS-050-0	7/3/02	5	6.5	1.42	J	1.03	1.95	0.34	U		
	1BH025-BS-135-0	7/3/02	13.5	15					0.29	U		
1BH026	1BH026-SS-000-5	7/11/02	0	1.5	**78.21**		6.17	3.44				
	1BH026-SS-000-0	7/11/02	0	1.5					**78**		4.28	
	1BH026-BS-015-0	7/11/02	1.5	2.5					11.1		0.706	
	1BH026-BS-050-0	7/11/02	5	6.5	-0.01	U	0.85	2.48	1.13	J	0.145	
	1BH026-BS-130-0	7/11/02	13	14.5					1.86	U		
1BH027	1BH027-SS-000-0	7/11/02	0	1.5	**85.74**		7.26	5.31	**72**		3.97	

Table 4-2
Total Uranium Results for Soil and Concrete Samples, AOC 1
(cont.)

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH027	1BH027-BS-015-0	7/11/02	1.5	2.9					-1.02	U		
	1BH027-BS-050-0	7/11/02	5	6.5	3.48		1.26	2.08	3.77	U		
	1BH027-BS-075-0	7/11/02	7.5	9					2.17	U		
1BH028	1BH028-SS-000-0	7/11/02	0	1.5	1.59	J	0.82	2.18	3.93	U		
	1BH028-BS-015-0	7/11/02	1.5	2.5					3.14	U		
	1BH028-BS-050-0	7/11/02	5	6.5	0.54	U	1.19	2.78	2.12	U		
	1BH028-BS-125-0	7/11/02	12.5	14					0.45	U		
1BH029	1BH029-SS-000-0	7/8/02	0	2	**29.14**		3.25	3.12	**62.3**		3.42	
	1BH029-BS-050-0	7/8/02	5	6.5	4.85		1.37	2.32	2.38	U		
1BH033	1BH033-CC-000-0	6/17/02	0	0.5	-17.79	U	2.57	1.77				
	1BH033-BS-020-0	6/20/02	2	3.5	0.35	UJ	0.72	1.5	3.12	U		
	1BH033-BS-050-0	6/20/02	5	6.5					3.04	U		
	1BH033-BS-075-0	6/20/02	7.5	9					1.2	U		
1BH034	1BH034-SS-000-0	6/26/02	0	1.5	**677.41**		49.8	10.14	**644**		35.1	
	1BH034-BS-015-0	6/26/02	1.5	3	**40.88**		4.47	2.58	**122**		6.64	
	1BH034-BS-025-0	6/26/02	2.5	4					**80.9**		4.47	
	1BH034-BS-050-0	6/26/02	5	6.5	3.56		1.36	1.9	3.48	U		
	1BH034-BS-135-0	6/26/02	13.5	15					2.02	U		
1BH035	1BH035-SS-000-0	7/9/02	0	1.5	**104.38**		8.27	4.59	**90.8**		4.98	
	1BH035-BS-015-0	7/9/02	1.5	2.5					3.01	U		
	1BH035-BS-050-0	7/9/02	5	6.5	4.19		1.14	2.71	2.51	U		
	1BH035-BS-135-0	7/9/02	13.5	15					3.25	U		
1BH036	1BH036-SS-005-0-1	7/16/02	0	1.5	**99,043**		7,051	474.6	**51,454**		19,107	122.4
	1BH036-SS-005-0-2	7/16/02	0	1.5	**19,041**		1,388	87.7	**12,256**		4,551	114.6
	1BH036-SS-005-0-3	7/16/02	0	1.5					**11,360**		4,214	62.5
1CPT-06	1CPT-06-B-P-1	11/16/04	1	2	**17.8**		7.9	11.5				
1-MW-07	1-MW-07-B-P-02	9/15/04	8	9	4.8	U	4.3	6.8				
	1-MW-07-B-P-01	9/15/04	9.5	10	-4.5	U	4.3	7.6				
1-MW-08	1-MW-08-B-P-01	9/17/04	4	4.5	**270**		34	10				
1-MW-17	1-MW-17-B-P-01	9/17/04	5	5.5	**46**		12	14				
	1-MW-17-B-P-02	9/17/04	9	9.5	9.8		2.9	3.7				
1-MW-21	1-MW-21-B-P-01	7/14/05	4	4.5	1.6	U	1.8	3				
	1-MW-21-B-P-02	7/24/05	7	7.5	-0.8	U	2	3.6				
1-MW-22	1-MW-22-B-P-01	7/15/05	3	3.5	3.1	U	3.7	6.1				
	1-MW-22-B-P-02	7/15/05	6	6.5	1.2	U	2	3.3				
1TP001	1TP001-BS-015-0	8/23/02	1.5	2					**14.7**		0.874	
1TP004	1TP004-BS-015-0	8/23/02	1.5	2					6.68		0.453	
1TP007	1TP007-BS-015-0	8/23/02	1.5	2	**132.63**		10.36	5.43	**111**		6.12	
1TP013	1TP013-BS-010-0	8/23/02	1	1.5					10.9		0.669	
1TP014	1TP014-BS-015-0	8/23/02	1.5	2					4.9		0.361	
1TP015	1TP015-BS-015-0	8/23/02	1.5	2					**14.4**		0.852	
1TP017	1TP017-BS-010-0	8/23/02	1	1.5					**23.5**		1.35	
1TP018	1TP018-BS-015-0	8/23/02	1.5	2					**27600**		1490	
1TP022	1TP022-BS-010-0	8/23/02	1	1.5	**432.11**		31.9	8.18	**652**		35.3	
1TP023	1TP023-BS-010-0	8/26/02	1	1.5					**121**		6.63	
1TP024	1TP024-BS-005-0	8/26/02	0.05	1					**363**		19.7	

Table 4-2
Total Uranium Results for Soil and Concrete Samples, AOC 1
(cont.)

					Offsite Gamma Spectroscopy				Onsite Gamma Spectroscopy			
Radionuclide					Uranium (Total)				Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1TP024	1TP024-BS-020-0	8/26/02	2	2.5	13.76		2.24	2.85	9.22		0.601	
1TP025	1TP025-CC-050-0-1	8/22/02	5	6.5	6.06		1.45	2.02				
1TP025	1TP025-CC-050-0-2	8/22/02	5	6.5	8.37		2.12	3.1				
1TP025	1TP025-CC-050-0-3	8/22/02	5	6.5	0.68	U	1.17	1.99				
1TP025	1TP025-BS-065-0-1	8/22/02	6.5	7					6.1		0.517	
Elevator Shaft	Elevator Shaft (0'-2')	8/18/03	0	2					**177**		66	3.69

					Offsite Alpha Spectroscopy			
Radionuclide					Uranium (Total)			
Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1-SB-01	1-SB-01-SS-P-00	6/25/07	0	1	9.2		1.7	0.2
1-SB-02	1-SB-02-SS-P-00	6/25/07	0	1	9.3		1.7	0.2
	1-SB-02-BS-P-01	6/25/07	1	2	**15.2**		2.7	0.1
1-SB-03	1-SB-03-SS-P-00	6/26/07	0	1	**14.7**		2.6	0.1
	1-SB-03-BS-P-04	6/26/07	4	5	4.75		0.98	0.11
1-SB-04	1-SB-04-SS-P-00	6/26/07	0	1	**14.1**		2.6	0.1
	1-SB-04-BS-P-01	6/26/07	1	2	**46.3**		7.7	0.1
1-SB-05	1-SB-05-SS-P-00	6/26/07	0	1	**16.9**		3	0.2

Notes:

ft bgs = feet below ground surface

TPU = Total Propagated Uncertainty

MDC = Minimum Detectable Concentration

pCi/g = picocuries per gram

U = Result is less than the sample specific MDC

J = Result is an estimated value

Shading indicates sample results exceeding the ISV of 14 pCi/g.

No onsite laboratory was used during monitoring well installation (2004) or additional sampling (2007)

Table 4-3
Radiological Isotopic Results for Soil and Concrete Samples, AOC 1

Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	RA-226 Gamma Spec				Th-230 Alpha Spec				Th-234 Gamma Spec				U-234 Alpha Spec				U-235 Alpha Spec				U-235 Gamma Spec				U-238 Alpha Spec			
					Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH001	1BH001-SS-000-0	7/10/02	0	1.5									9.63		1.82	1.2									0.65		0.26	0.35				
	1BH001-BS-050-0	7/10/02	5	6.5									2.11	J	1.22	1.31									0.1	U	0.27	0.46				
1BH002	1BH002-SS-000-0	6/26/02	0	1.5									54.03		6.01	1.94									3.68		0.56	0.5				
	1BH002-BS-050-0	6/26/02	5	6.5									-0.11	U	0.67	1.21									0.11	U	0.22	0.38				
	1BH002-BS-080-0	6/26/02	9	9.5					0.38	J	0.1	0.09																				
1BH003	1BH003-SS-000-0	7/9/02	0	1.5									19.63		2.6	1.43									1.48		0.32	0.4				
	1BH003-BS-050-0	7/9/02	5	6.5									1.1	J	0.87	1.04									0.03	U	0.21	0.35				
1BH004	1BH004-SS-000-0	6/26/02	0	1.5									4.19		1.4	1.32									0.14	UJ	0.42	0.55				
	1BH004-BS-080-0	6/26/02	8	9.5									2.14	J	1.34	1.33									0.26	U	0.32	0.58				
1BH005	1BH005-CC-000-0	6/14/02	0	0.5									1.49	J	1.12	1.02	5.34		1.17	0.15	0.16	J	0.13	0.07	0.1	U	0.21	0.38	5.1		1.13	0.1
	1BH005-BS-040-0	6/14/02	4	4.5									4.81		1.13	1.1	3.11		0.75	0.11	0.14	J	0.11	0.11	0.04	U	0.23	0.42	3	J	0.73	0.12
1BH006	1BH006-SS-000-0	7/2/02	0	1.5									0.07	UJ	1.26	1.16									0.04	U	0.25	0.43				
	1BH006-BS-055-0	7/2/02	5.5	6.5									3.3		1.28	1.13									0.21	UJ	0.36	0.42				
	1BH006-BS-085-0	7/2/02	8.5	10					1.14	J	0.25	0.09																				
1BH007	1BH007-SS-000-0	6/25/02	0	1.5									0.29	UJ	0.66	0.71									0.17	J	0.16	0.3				
	1-BH-007-02	8/15/03	0	2					0.55		0.13	0.08																				
	1-BH-007-04	8/15/03	2	4					0.49		0.12	0.08																				
	1BH007-BS-040-0	6/25/02	4	5									0.67	UJ	0.84	1.01									-0.01	U	0.24	0.4				
1BH008	1BH008-CC-000-0	6/19/02	0	0.5									0.3	UJ	0.59	0.61	1.52		0.45	0.13	0.02	UJ	0.05	0.11	0.03	U	0.13	0.23	0.93		0.32	0.12
	1BH008-BS-010-0	6/19/02	1	2.5									0.98	J	0.84	0.86	0.91		0.31	0.12	0.04	UJ	0.06	0.1	0.03	U	0.18	0.32	0.64	J	0.25	0.11
1BH009	1BH009-CC-000-0	6/18/02	0	0.5									2.76	J	0.75	0.61	3.89		1.07	0.23	0.18	J	0.16	0.1	0.14	UJ	0.18	0.23	3.55		0.99	0.19
	1BH009-BS-000-0	6/18/02	0	1.5									105		11.46	2.85	125.2	L	25.69	0.67	6.06	J	2.93	0.82	8.45		0.79	0.77	130.7	J	26.71	1.13
	1BH009-BS-020-0	6/18/02	2	3.5									1.63	J	0.9	0.91	1.67		0.48	0.14	0.08	UJ	0.09	0.07	0.1	U	0.19	0.33	1.55	J	0.46	0.06
1BH010	1BH010-CC-000-0	6/17/02	0	0.5									-0.19	UJ	0.55	0.99	1.39		0.61	0.35	0.1	UJ	0.16	0.26	0.02	U	0.17	0.29	0.72		0.4	0.12
	1BH010-BS-000-0	6/17/02	0	0.75									8.87		1.28	0.89	8.17		1.68	0.14	0.54	J	0.25	0.15	0.71		0.27	0.29	7.85	J	1.62	0.12
	1BH010-BS-020-0	6/17/02	2	3.5									1.18	J	0.72	0.72	1.11		0.37	0.1	0.04	UJ	0.07	0.14	0.09	U	0.15	0.27	1	J	0.34	0.11
1BH011	1BH011-SS-000-0	7/8/02	0	1.5									1.54	J	0.82	0.89									0.24	J	0.18	0.33				
	1BH011-BS-050-0	7/8/02	5	6.5									0.62	J	0.57	0.64									-0.06	U	0.13	0.22				
1BH012	1BH012-SS-000-0	6/21/02	0	1									2.4	J	0.69	0.58									0.09	U	0.14	0.21				
	1BH012-BS-050-0	6/21/02	5	6									0.37	UJ	0.5	0.51									0	UJ	0.11	0.2				
1BH013	1BH013-BS-025-0	6/21/02	2.5	4									0.25	UJ	0.52	0.62									0.03	U	0.15	0.26				
	1BH013-BS-060-0	6/21/02	6	8									0.96	J	0.72	0.96									-0.1	U	0.21	0.37				
1BH014	1BH014-SS-000-0	6/20/02	0	1.5									10.26		1.67	1.08	10.04		2.03	0.16	0.27	J	0.18	0.07	0.47	J	0.31	0.37	10.49	J	2.11	0.1
	1BH014-BS-040-0	6/20/02	4	5									0.75	UJ	0.78	0.79	1.72		0.51	0.2	0.1	UJ	0.11	0.15	-0.01	U	0.17	0.29	1.26	J	0.41	0.18
1BH015	1BH015-CC-000-0	6/19/02	0	0.5									3.43	J	0.85	0.61	7.42		2.27	0.39	0.34	J	0.32	0.18	0.19	J	0.14	0.21	7.42		2.27	0.53
	1BH015-BS-000-0	6/19/02	0	1.5									2.46		0.89	0.86	2.7		0.71	0.11	0.11	UJ	0.11	0.13	0.13	U	0.17	0.31	3.23	J	0.81	0.14
1BH016	1BH016-SS-000-0	7/1/02	0	1.5									29.86		3.96	2									1.36		0.46	0.51				
	1BH016-BS-050-0	7/1/02	5	7									-0.23	U	0.8	1.32									0.05	U	0.27	0.49				
	1BH016-BS-080-0	7/1/02	8	9.5					1.12	J	0.23	0.09																				
1BH017	1BH017-SS-000-0	7/2/02	0	2									0.35	UJ	0.55	0.48									0.03	U	0.12	0.2				
	1BH017-BS-050-0	7/2/02	5	6.5									0.57	UJ	0.68	0.72									0.1	U	0.17	0.3				
1BH018	1BH018-SS-000-0	6/25/02	0	1.5									10.04	J	1.8	1.44									0.16	UJ	0.43	0.53				
	1-BH-018-02	8/15/03	0	2					1.68	J	0.34	0.09																				
	1-BH-018-04	8/15/03	2	4					0.85	J	0.19	0.08																				
	1BH018-BS-055-0	6/25/02	5.5	7									0.12	UJ	0.7	1.28									-0.08	U	0.24	0.4				
1BH019	1BH019-SS-000-0	6/25/02	0	1.5									1.25	J	1.01	1.08									0.31	J	0.3	0.38				
	1BH019-BS-035-0	6/25/02	3.5	5					0.7	J	0.16	0.08																				
	1BH019-BS-050-0	6/25/02	5	6									2.51	J	1.31	1.24									-0.2	U	0.27	0.44				
1BH020	1BH020-SS-000-0	6/24/02	0	1.5									0.44	UJ	0.73	1.34									0.01	U	0.24	0.4				
	1BH020-BS-065-0	6/24/02	6.5	8									0.33	UJ	0.9	0.77									0.07	U	0.19	0.33				
1BH021	1BH021-SS-000-0	6/24/02	0	1.5									1.81	J	0.74	1.04									0.19	UJ	0.3	0.41				
	1BH021-BS-085-0	6/24/02	8.5	10									0.79	J	0.61	0.62									0.01	U	0.15	0.24				
1BH022	1BH022-CC-000-0	6/17/02	0	0.5									13.55	J	2.08	1.21	16.83	L	5.09	0.59	0.73	J	0.55	0.52	0.68	L	0.24	0.3	13.74	L	4.24	0.54
	1BH022-BS-000-0	6/17/02	0	1									3.63		0.97	0.78	4.32		0.96	0.09	0.14	J	0.12	0.13	0.08	UJ	0.26	0.3	3.91	J	0.89	0.11
1BH023	1BH023-SS-000-0	7/1/02	0	1.5									2		0.84	0.76									-0.11	U	0.18	0.3				
	1BH023-BS-050-0	7/1/02	5	7									1	J	0.75	0.75									-0.15	U	0.17	0.27				
1BH024	1BH024-SS-000-0	7/3/02	0	1.5									2.22		0.62	0.71									0.23	UJ	0.28	0.34				
	1BH024-BS-050-0	7/3/02	5	7									0.36	U	0.71	1.31									-0.09	U	0.23	0.39				

Table 4-3
Radiological Isotopic Results for Soil and Concrete Samples, AOC 1
(cont.)

Sample Location	Sample ID	Sample Date	Start Depth (ft)	End Depth (ft)	RA-226 Gamma Spec				Th-230 Alpha Spec				Th-234 Gamma Spec				U-234 Alpha Spec				U-235 Alpha Spec				U-235 Gamma Spec				U-238 Alpha Spec			
					Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
1BH025	1BH025-SS-000-0	7/3/02	0	1.5									4.85		1.05	1									0.16	UJ	0.42	0.42				
	1BH025-BS-050-0	7/3/02	5	6.5									0.67	UJ	0.72	0.82									0.09	U	0.18	0.32				
1BH026	1BH026-SS-000-5	7/11/02	0	1.5									37.77		4.35	1.5									2.67		0.36	0.44				
	1BH026-BS-050-0	7/11/02	5	6.5									-0.05	U	0.59	1.07									0.09	U	0.19	0.33				
1BH027	1BH027-SS-000-0	7/11/02	0	1.5									41.68		5.12	2.36									2.38		0.55	0.6				
	1BH027-BS-050-0	7/11/02	5	6.5									1.64	J	0.87	0.88									0.19	UJ	0.26	0.32				
1BH028	1BH028-SS-000-0	7/11/02	0	1.5									0.77	J	0.57	0.92									0.05	U	0.2	0.35				
	1BH028-BS-050-0	7/11/02	5	6.5									0.22	U	0.82	1.19									0.1	U	0.25	0.39				
1BH029	1BH029-SS-000-0	7/8/02	0	2									14.04		2.29	1.37									1.06		0.32	0.38				
	1BH029-BS-050-0	7/8/02	5	6.5									2.4		0.96	0.96									0.04	U	0.23	0.41				
1BH033	1BH033-CC-000-0	6/30/02	0	0.5									-1.73	UJ	1.48	0.76	1.84		0.6	0.22	0.06	UJ	0.1	0.16	-14.34	U	1.49	0.25	1.61		0.54	0.13
	1BH033-BS-020-0	6/30/02	2	3.5									0.18	UJ	0.5	0.62	0.87		0.31	0.14	0.02	UJ	0.05	0.07	-0.01	U	0.15	0.27	0.69	J	0.27	0.12
1BH034	1BH034-SS-000-0	6/28/02	0	1.5									327.3		35.19	4.54	347.2		84.86	21.24	21.45	J	16.37	15.19	22.81		1.89	1.05	340.8		83.45	17.6
	1BH034-BS-015-0	6/28/02	1.5	3									24.96		3.07	1.06	58.62		11.8	1.03	4.51		2.12	1.27	-9.04	U	1.08	0.45	59.39		11.92	1.02
	1BH034-BS-050-0	6/28/02	5	6.5									1.69	J	0.96	0.79									0.19	J	0.17	0.32				
	1BH034-BS-125-0	6/28/02	12.5	14					0.47	J	0.12	0.08																				
1BH035	1BH035-SS-000-0	7/9/02	0	1.5									50.6		5.84	2.04									3.18		0.4	0.5				
	1BH035-BS-050-0	7/9/02	5	6.5									2.1		0.79	1.17									-0.01	U	0.23	0.38				
1BH036	1BH036-BS-005-0	7/16/02	0.5	2					64	J	11	0																				
1CPT-06	1CPT-06-B-P-1	11/16/04	1	2	0.39	U	0.19	0.46					8.7		3.9	5.6									0.38	U	0.22	0.43				
1-MW-06	2-MW-06-B-P-01	11/16/04	2	3									2.8	U	2.4	3.9									-0.01	U	0.3	0.52				
1-MW-07	1-MW-07-B-P-02	9/16/04	8	9									2.3	U	2.1	3.3									0.02	U	0.25	0.44				
	1-MW-07-B-P-01	9/16/04	9.5	10									-2.2	U	2.1	3.7									-0.23	U	0.24	0.44				
1-MW-08	1-MW-08-B-P-01	9/17/04	4	4.5									132		17	5									7.6		1.3	1.5				
1-MW-17	1-MW-17-B-P-01	9/17/04	5	5.5									22.3		5.6	6.7									1.55		0.44	0.65				
	1-MW-17-B-P-02	9/17/04	9	9.5									4.8		1.4	1.8									0.44	U	0.34	0.52				
1-MW-21	1-MW-21-B-P-01	7/14/05	4	4.5	0.99		0.28	0.59					0.78	U	0.9	1.46									0	U	0.31	0.54				
	1-MW-21-B-P-02	7/14/05	7	7.5	1.36		0.3	0.39					-0.39	U	0.98	1.75									0.25	U	0.29	0.47				
1-MW-22	1-MW-22-B-P-01	7/15/05	3	3.5	2.26		0.46	0.59					1.5	U	1.8	3									0.4	U	0.56	0.93				
	1-MW-22-B-P-02	7/15/05	6	6.5	1.66		0.38	0.61					0.57	U	0.97	1.61									0	U	0.33	0.57				
1-SB-01	1-SB-01-SS-P-00	6/25/07	0	1	0.53	G	0.2	0.42	0.73		0.15	0.08	2.5	U,M,G	4.1	6.9	4.89	M3	0.91	0.11	0.22		0.11	0.06	0.29	U,G	0.38	0.63	4.49		0.84	0.08
	1-SB-01-BS-P-02	6/25/07	2	3	1.36	G	0.3	0.5	1.27		0.24	0.09	203	M3,G	29	17	205	M3	31	0	9.5		1.6	0	9.9	G	1.5	1.3	203	M3	31	0
1-SB-02	1-SB-02-SS-P-00	6/26/07	0	1	0.34	U,G	0.16	0.36	0.29		0.082	0.08	3.5	U,M,G	5	8.2	4.48		0.83	0.08	0.197		0.099	0.052	0.12	U,G	0.34	0.59	4.57		0.84	0.07
	1-SB-02-BS-P-01	6/26/07	1	2	0.42	LT	0.18	0.4	0.64		0.15	0.10	6.5	M3	4.1	6.1	7.8		1.4	0.1	0.47		0.16	0.05	0.51	U	0.34	0.52	7.4		1.3	0.1
1-SB-03	1-SB-03-SS-P-00	6/26/07	0	1	0.53	G	0.19	0.38	0.51		0.11	0.08	3.8	U,M,G	8.3	14	6.8		1.2	0.1	0.33		0.13	0.03	0.04	U,G	0.48	0.84	7.2		1.3	0
	1-SB-03-BS-P-04	6/26/07	4	5	0.56	G	0.17	0.32	0.37		0.093	0.08	2.8	U,M,G	4	6.6	2.69		0.54	0.07	0.23		0.11	0.06	-0.02	U,G	0.3	0.55	2.32		0.48	0.05
1-SB-04	1-SB-04-SS-P-00	6/26/07	0	1	0.62	G	0.21	0.44	0.60		0.12	0.07	7	U,M,G	9.1	15	6.6		1.2	0.1	0.35		0.15	0.08	0.15	U,G	0.55	0.94	6.9		1.2	0.1
	1-SB-04-BS-P-01	6/26/07	1	2	2.07	G	0.37	0.41	1.83		0.31	0.08	33.8	G	5.2	3.3	22.3		3.7	0.1	1.08		0.29	0.06	2.23	G	0.57	0.82	22.6		3.8	0
1-SB-05	1-SB-05-SS-P-00	6/26/07	0	1	0.67	G	0.2	0.44	0.56		0.12	0.08	7.2	U,M,G	5.6	8.7	7.9		1.4	0.1	0.42		0.16	0.07	0.35	U,G	0.44	0.73	8.3		1.5	0.1
	1-SB-05-BS-P-03	6/26/07	3	4	0.68		0.2	0.35	0.43		0.11	0.08	232	M3	31	14	263	M3	40	0	12.8	M3	2.1	0.1	13.5		1.8	1.2	266	M3	40	0
1TP004	1TP007-BS-015-0	8/26/03	1.5	2									63.85		7.32	2.42	58.76		16.27	5.66	2.39	UJ	3.16	4.86	4.93		0.54	0.59	53.2		15.16	4.37
1TP022	1TP022-BS-010-0	8/26/03	1	1.5									208.6		22.54	3.63	166.5		42.79	12.37	11.43	J	9.81	9.07	14.91		1.27	0.93	154.2		40.41	9.54
1TP024	1TP024-BS-020-0	8/26/03	2	2.5									6.66		1.55	1.2									0.44	UJ	0.45	0.45				
1TP025	1TP025-CC-050-0-1	8/22/03	5	6.5									2.96		1	0.84									0.15	UJ	0.33	0.34				
	1TP025-CC-050-0-2	8/22/03	5	6.5									4.04		1.48	1.31	4.84		2	1.33	0.6	UJ	0.71	0.55	0.28	UJ	0.36	0.48	4.9		1.99	1.14
	1TP025-CC-050-0-3	8/22/03	5	6.5									0.17	UJ	0.8	0.82									0.35	J	0.31	0.36				
ElevatorShaft	Elevator Shaft (0-2)	8/18/03	0	2					8.7	J	1.4	0.1																				

Notes:

TPU = Total Propagated Uncertainty
MDC = Minimum Detectable Concentration
pCi/g = picocuries per gram
U = Result is less than the sample specific MDC
J = Result is an estimated value
M = The requested MDC not met
G = Sample density differs by more than 15% of LCS density: sample results may be biased
LT = Result is less than requested MDC but greater than sample specific MDC
M3 = The requested MDC was not met but the reported activity is greater than the reported MDC

Table 4-4
Metals Exceeding Preliminary Remediation Goals in Soil Samples, AOC 1

Analyte			ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD	
NJDEP SCC (mg/kg)			14		20		NA		NA		400	
Region 6 PRG (mg/kg)			**31.3**		**0.39**		**30.1**		**54750**		**400**	
Sample ID	**Sample Date**	**Start Depth/ End Depth (ft)**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**
1BH004-BS-050-0	6/26/02	5 / 7			3.9							
1BH007-BS-055-0	6/25/02	5.5 / 6.5			2.8							
1BH013-BS-050-0	6/21/02	5 / 6			2.7							
1BH013-BS-090-0	6/21/02	9 / 9.5			8.1							
1BH018-BS-080-0	6/25/02	8 / 9			2.4		35.1					
1BH026-SS-000-0	7/11/02	0 / 1.5			1.3							
1BH033-BS-020-0	6/20/02	2 / 3.5			0.92							
1BH036-BS-005-0	7/16/02	0.25 / 0.75			40.7						459	
1-SB-01-BS-P-02	6/25/07	2 / 3	56		34				130000			
1-SB-01-SS-P-00	6/25/07	0 / 1					40		63000			
1-SB-02-BS-P-01	6/25/07	1 / 2			16		95		150000		1300	
1-SB-02-SS-P-00	6/25/07	0 / 1			3						1300	
1-SB-03-BS-P-04	6/26/07	4 / 5			2.3							
1-SB-03-SS-P-00	6/26/07	0 / 1			1.7							
1-SB-04-BS-P-01	6/26/07	1 / 2			5.3							
1-SB-04-SS-P-00	6/26/07	0 / 1			2.4							
1-SB-05-BS-P-03	6/26/07	3 / 4			2.6							
1-SB-05-SS-P-00	6/26/07	0 / 1			1.6							

Notes:

mg/kg = milligrams per kilogram

PRG = Preliminary Remediation Goal

NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria

Table 4-5
VOCs and SVOCs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 1

Sample ID			1BH004-BS-0500		1BH007-BS-0555-0		1BH013-BS-0500		1BH013-BS-0900		1BH018-BS-0800		1BH036-BS-0050		1-SB-01-BS-P-02		1-SB-01-SS-P-00		1-SB-03-BS-P-04		1-SB-03-SS-P-00		1-SB-04-BS-P-01		1-SB-04-SS-P-00		1-SB-05-SS-P-00	
Sample Date			6/26/02		6/25/02		6/21/02		6/21/02		6/25/02		6/20/02		6/25/07		6/25/07		6/26/07		6/26/07		6/26/07		6/26/07		6/26/07	
StartDepth / EndDepth (ft bgs)			5 / 7		5.5 / 6.5		5 / 6		9 / 9.5		8 / 9		0.25 / 0.75		2 / 3		0 / 1		4 / 5		0 / 1		1 / 2		0 / 1		0 / 1	
	NJDEP SCC (ug/kg)	**Reg 6 PRG (ug/kg)**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**
SVOC																												
1,2,4-TRICHLOROBENZENE	68000	**143000**					950000		1200000																			
1,4-DICHLOROBENZENE	570000	**3200**					720000																					
NAPHTHALENE	230000	**125000**			1600000		1400000		1200000		370000																	
VOC																												
BENZENE	3000	**656**	740	J							6800	J																
METHYLENE CHLORIDE	49000	**8900**									13000	B																
TRICHLOROETHENE	23000	**42.6**			370	J	1300	J																				
Xylene (total)	410000	**214000**									240000																	

Notes:

ug/kg = micrograms per kilogram
PRG = Preliminary Remediation Goal
NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria
ft bgs - feet below ground surface
J= Result is an estimated value
B=Analyte is detected in blank as well as sample
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table 4-6
PAHs and PCBs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 1

Sample ID			1BH036-BS-005-0		1-SB-01-BS-P-02		1-SB-01-SS-P-00		1-SB-03-BS-P-04		1-SB-03-SS-P-00	
Sample Date			7/16/02		6/25/07		6/25/07		7/16/02		6/26/07	
StartDepth / EndDepth (ft bgs)			0.25 / 0.75		2 / 3		0 / 1		4 / 5		0 / 1	
	NJDEP SCC (ug/kg)	**Reg 6 PRG (ug/kg)**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**
PAHs												
BENZO(A)ANTHRACENE	900	**148**			3600		250					
BENZO(A)PYRENE	660	**14.8**			2700		220		33		76	
BENZO(B)FLUORANTHENE	900	**148**			3300		630					
DIBENZO(A,H)ANTHRACENE	660	**14.8**			560		48				16	
INDENO(1,2,3-CD)PYRENE	900	**148**			1500	B	150					
PCBs												
AROCLOR-1254	NA	**222**	12000				3700					
AROCLOR-1260	NA	**222**										
Pesticides												
ALDRIN	40	**28.6**	46	I								

Sample ID			1-SB-04-BS-P-01		1-SB-04-SS-P-00		1-SB-05-SS-P-00					
Sample Date			6/26/07		6/26/07		6/26/07					
StartDepth / EndDepth (ft bgs)			1 / 2		0 / 1		0 / 1					
	NJDEP SCC (ug/kg)	**Reg 6 PRG (ug/kg)**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**				
PAHs												
BENZO(A)ANTHRACENE	900	**148**	1400									
BENZO(A)PYRENE	660	**14.8**	1100		87		78					
BENZO(B)FLUORANTHENE	900	**148**	1600									
DIBENZO(A,H)ANTHRACENE	660	**14.8**	180		20		17					
INDENO(1,2,3-CD)PYRENE	900	**148**	490									
PCBs												
AROCLOR-1254	NA	**222**										
AROCLOR-1260	NA	**222**					920					
Pesticides												
ALDRIN	40	**28.6**										

Notes:

ft bgs - feet below ground surface
NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria
PRG = Preliminary Remediation Goal
ug/kg = micrograms per kilogram
B = Analyte is detected in blank as well as sample
I = Interference
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenols

Table 4-7
Total Uranium and Radiological Field Instrument Results, Elevator Shaft Test Pit Investigation, AOC 1

Location	Field Sample ID	Sample Date	Depth (ft bgs)		Total Uranium												Direct Field Readings		Wipe Samples Readings	
					Gamma Spec Off-Site				Gamma Spec On-Site				Alpha Spec Off-Site							
			Top	Bottom	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Beta Ludlum 2360 (dpm/100 cm^2)	Alpha Ludlum 2360 (dpm/100 cm^2)	Beta Ludlum 2929 (dpm/100 cm^2)	Alpha Ludlum 2929 (dpm/100 cm^2)
1TP025	1TP025-BRICK	8/22/02	0	6.5													8,108	90	<MDA	<MDA
	1TP025-BRICK2	8/22/02	0	6.5													60,439	107	<MDA	<MDA
	1TP025-BRICK3	8/22/02	0	6.5													3,685	90	<MDA	<MDA
	1TP-025-BS-065-0-1	8/22/02	6.5	7					6.10	3.54		4.45								
	1TP-025-BS-065-0-2	8/22/02	6.5	7	58.2	5.15		3.85	3.59	2.33		3.14								
	1TP-025-BS-065-0-3	8/22/02	6.5	7					6.36	3.17		3.38								
	1TP-025-CC-050-0-1	8/22/02	5	6.5	6.06	1.45		2.02												
	1TP-025-CC-050-0-2	8/22/02	5	6.5	8.38	2.12		3.10					10.34	2.91						
	1TP-025-CC-050-0-3	8/22/02	5	6.5	0.68	1.17	U	1.99												
	1TP-025-CHANNEL	8/22/02	0	6.5													283,092	1,957	1,654	247
	1TP-025-DIRT	8/22/02	0	6.5													3,769	82	<MDA	<MDA
	1TP-025-METAL	8/22/02	0	6.5													4,262	107	<MDA	<MDA
	1TP-025-SHEET	8/22/02	0	6.5													51,585	98	92	54
	1TP-025-SPRINGS	8/22/02	0	6.5													41,100	115	<MDA	<MDA
	1TP-025-SPRINGS2	8/22/02	0	6.5													23,977	307	<MDA	<MDA
	1TP-025-SUMP	8/22/02	0	6.5													32,462	107	<MDA	<MDA

Notes:

ft bgs - feet below ground surface
dpm = disintegrations per minute
cm^2 = centimeters squared
MDA = Minimum Detectable Activity
MDC = Minimum Detectable Concentration
pCi/g = picocuries per gram
U = result-uncertainity < 0
Shading indicates sample results exceeding the ISV of 14 pCi/g
TPU = Total Propagated Uncertainty

Table 4-8
Total Uranium and Radiological Field Instrument Results, Uranium Oxide Test Pit Investigation, AOC 1

Location	Field Sample ID	Sample Date	Depth (ft bgs)		Total Uranium												Rad Field Instruments		
					Gamma Spec Off-Site				Gamma Spec On-Site				Alpha Spec Off-Site						
			Top	Bottom	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Result (pCi/g)	TPU [+/- 2σ]	Flag	MDC	Downhole Gamma (cpm)	Beta Gamma Frisk (cpm)	Micro R Meter (mR/hr)
1TP001	1TP001-BS-015-0	8/23/02	1.5	2					**14.66**	5.99		3.72					15,176		50
1TP002		8/23/02	1.5	1.5															20
1TP003		8/23/02	1.5	1.5															8
1TP004	1TP-004-BS-015-0	8/23/02	1.5	2					6.67	3.10		2.91					10,598		15
1TP005		8/23/02	1.5	1.5															10
1TP006		8/23/02	1.5	1.5															10
1TP007	1TP-007-BS-015-0	8/23/02	1.5	2	**132.63**	10.36		5.43	**111.33**	41.92		10.55	**114.35**	22.46		14.89	18,863		30
	1TP-007-BS-015-1	8/23/02	1.5	2	**157.82**	12.52		7.39					**168.08**	27.3		8.05			
1TP008		8/23/02	1.5	1.5															12
1TP009		8/23/02	1.5	1.5															9
1TP010		8/23/02	1.5	1.5													19,373		25
1TP012		8/23/02	1.5	1.5															18
1TP013	1TP-013-BS-010-0	8/23/02	1	1.5					10.86	4.58		3.27							25
1TP014	1TP014-BS-015-0	8/23/02	1.5	2					4.89	**2.48**		2.64							100
1TP015	1TP015-BS-015-0	8/23/02	1.5	2					**14.42**	5.84		3.46							25
1TP016		8/23/02	1.5	1.5															10
1TP017	1TP017-BS-010-0	8/23/02	1	1.5					**23.48**	92.7		4.61							25
1TP018	1TP018-BS-015-0	8/23/02	1.5	2					**27,582.12**	10,239.34		194.22							300
1TP019		8/23/02	1.5	1.5															150
1TP020		8/23/02	1.5	1.5															50
1TP021		8/23/02	1.5	1.5															6
1TP022	1TP022-BS-010-0	8/25/02	1	1.5	**432.11**	31.9		8.18	**652.04**	242.26		16.67	**332.13**	59.67		30.98		1,000	100
	1TP022-BS-010-1	8/25/02	1	1.5	**828.53**	62.7		20.73					**475.79**	73.4		18.23			
1TP023	1TP023-BS-010-0	8/25/02	1	1.5				2.85	**121.38**	45.47		8.59						200	20
1TP024	1TP024-BS-005-0	8/25/02	0.05	1					**362.69**	135.19		17.72						20,000	25
	1TP024-BS-020-0	8/25/02	2	2.5	13.76	2.24			9.21	4.12		3.61							

Notes:

cpm = Counts per minute

TPU = Total Propagated Uncertainty

µR/hr = microroentgen per hour

ft bgs - feet below ground surface

MDC = Minimum Detectable Concentration

pCi/g = Picocuries per gram

Shading indicates sample results exceeding the ISV of 14 pCi/g

Table 4-9
Total Uranium Results for Soil and Concrete Samples, AOC 2

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2BH001	2BH001-BS-005-0	7/19/02	0.5	2	4.76	1.57	1.78	4.37 U		
	2BH001-BS-050-0	7/19/02	5	6.5	0.77 UJ	0.99	2.56	1.96 U		
	2BH001-BS-120-0	7/19/02	12	13.5				0.50 U		
2BH002	2BH002-BS-005-0	7/19/02	0.5	2	1.25 UJ	1.95	2.78	3.51 U		
	2BH002-BS-050-0	7/19/02	5	6.5	1.24 J	0.86	1.73	1.73 U		
	2BH002-BS-125-0	7/19/02	12.5	14				-0.08 U		
2BH003	2BH003-SS-000-0	7/19/02	0	1.5	3.45 J	1.08	2.59	3.82 U		
	2BH003-BS-015-0	7/19/02	1.5	3				1.39 U		
	2BH003-BS-050-0	7/19/02	5	6.5	3.81 J	2.76	3.45	0.58 U		
	2BH003-BS-120-0	7/19/02	12	13.5				1.00 U		
2BH004	2BH004-SS-000-0	7/26/02	0	1.5	11.91	2.18	2.57	5.24	0.41	
	2BH004-BS-050-0	7/26/02	5	6.5	1.85 J	1.45	2.81	1.65 U		
	2BH004-BS-135-0	7/26/02	13.5	15				0.58 U		
2BH005	2BH005-BS-005-0	7/22/02	0.5	2	2.47 J	1.11	1.69	1.34 U		
	2BH005-BS-020-0	7/22/02	2	3.7				1.18 U		
	2BH005-BS-050-0	7/22/02	5	6.5	-0.5 UJ	0.97	2.72	2.83 U		
	2BH005-BS-125-0	7/22/02	12.5	14				4.92 U		
2BH006	2BH006-BS-005-0	7/22/02	0.5	2	0.33 UJ	0.97	1.93	3.04 U		
	2BH006-BS-020-0	7/22/02	2	3.5				4.9 U		
	2BH006-BS-070-0	7/22/02	7	8.5	1.91 J	1.46	2.21	2.02 J	0.26	
	2BH006-BS-125-0	7/22/02	12.5	14				3.06 U		
2BH007	2BH007-BS-005-0	7/22/02	0.5	2	0.65 UJ	0.93	2.69	2.54 U		
	2BH007-BS-020-0	7/22/02	2	3.5				2.46	0.24	
	2BH007-BS-050-0	7/22/02	5	6.5	0.27 UJ	1.02	1.79	2.59 U		
	2BH007-BS-125-0	7/22/02	12.5	14				-0.733 U		
2BH008	2BH008-BS-005-0	7/19/02	0.5	2	1.54 J	1.25	1.68	2.46 U		
	2BH008-BS-030-0	7/19/02	3	4.5				1.36 U		
	2BH008-BS-050-0	7/24/02	5	6.5	2.47 J	1.29	2.25	1.2 U		
	2BH008-BS-135-0	7/24/02	13.5	15				4.4 U		
2BH009	2BH009-BS-005-0	7/26/02	0.5	2	4.71	1.47	2.25	2.28	0.22	
	2BH009-BS-020-0	7/26/02	2	3.5				8.77	0.62	
	2BH009-BS-050-0	7/26/02	5	6.5	1.24 J	1.05	1.86	0.84 J	0.13	
	2BH009-BS-125-0	7/26/02	12.5	14				1.75 U		
2BH010	2BH010-BS-005-0	7/26/02	0.5	2	**119.4**	9.68	6.17	**159**	8.67	
	2BH010-BS-020-0	7/26/02	2	3.5				3.14	0.22	
	2BH010-BS-050-0	7/26/02	5	6.5	2.38 J	1.25	3.03	6.44 U		
	2BH010-BS-080-0	7/26/02	8	9.5				1.36 U		
	2BH010-BS-125-0	7/29/02	12.5	14				2.72 U		
2BH011	2BH011-SS-000-0	7/11/02	0	1.5	5.42	1.19	1.91	3.69	0.32	
	2BH011-BS-015-0	7/11/02	1.5	3				3.19	0.28	
	2BH011-BS-050-0	7/11/02	5	6	0.28 U	0.5	1.45	1.39 U		
	2BH011-BS-130-0	7/11/02	13	14				2.78 U		
2BH012	2BH012-BS-005-0	8/8/02	0.5	2	3.79	1.23	2.39	1.75 J	0.217	
	2BH012-BS-020-0	8/8/02	2	3.5				4.03 U		
	2BH012-BS-050-0	8/8/02	5	6.5	0.89 U	1.3	2.8	3.3 U		
	2BH012-BS-125-0	8/8/02	12.5	14				1.00 U		
2BH013	2BH013-BS-005-R	8/8/02	0.5	2	1.62 J	1.5	3.02	2.36 U		
	2BH013-BS-020-R	8/7/02	2	3.5				1.1 J	0.20	
	2BH013-BS-050-R	8/7/02	5	6.5	0.76 U	1.06	1.83	1.83 U		
	2BH013-BS-135-R	8/7/02	13.5	15				-0.52 U		
2BH014	2BH014-BS-005-0	7/27/02	0.5	2				-1.2 U		
	2BH014-BS-005-R	7/24/02	0.5	2	0.1 UJ	0.82	2.32	-0.08 U		

Table 4-9
Total Uranium Results for Soil and Concrete Samples, AOC 2
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2BH014	2BH014-BS-020-R	7/24/02	2	3				1.1 U		
	2BH014-BS-020-0	7/24/02	2	3.5				1.62 J	0.21	
	2BH014-BS-050-0	7/22/02	5	6.5	2.58 J	1.6	2.19	5.92 U		
	2BH014-BS-135-0	7/20/02	13.5	15				1.15 U		
2BH015	2BH015-BS-005-R	7/20/02	0.5	1.3	0.76 J	0.73	1.82	2.28 U		
	2BH015-BS-005-0	7/20/02	0.5	2				-2.57 U		
	2BH015-BS-020-R	7/20/02	2	2.9				1.73 U		
	2BH015-BS-020-0	7/20/02	2	3.5				0.37 U		
	2BH015-BS-040-R	7/20/02	4	4.8				0.18 U		
	2BH015-BS-050-0	7/20/02	5	6.5				3.88 U		
	2BH015-CC-065-R	8/20/02	6.5	7.85	3.59 J	1.74	2.81			
	2BH015-BS-080-R	7/20/02	8	8.8	1.48 J	1.4	3.13	4.24 U		
	2BH015-BS-100-R	7/20/02	10	10.8				4.19 U		
2BH016	2BH016-BS-005-0	7/19/02	0.5	2	1.53 J	1.03	1.91	2.64 U		
	2BH016-BS-020-0	7/19/02	2	3.5				1.91 U		
	2BH016-BS-050-0	7/19/02	5	6.5	3.02 J	1.19	2.21	0.183 U		
	2BH016-BS-120-0	7/19/02	12	13.5				4.56 U		
2BH017	2BH017-BS-005-0	8/2/02	0.5	2	2.51 J	1	2.96	1.81	0.14	
	2BH017-BS-020-0	8/2/02	2	3.5				3.4	0.29	
	2BH017-BS-050-0	8/2/02	5	6.5	0.53 U	1.56	2.98	2.3 U		
	2BH017-BS-120-0	8/2/02	12	13.5				2.38 U		
2BH018	2-BH-018-02 (0'-2')	8/13/03	0	2				**1630**	605	14
	2BH018-BS-005-0	7/31/02	0.5	1.75	**21.59**	2.37	2.27	**22.7**	1.3	
	2BH018-BS-020-0	7/31/02	2	3				**4010**	217	
	2BH018-BS-025-0	7/31/02	2.5	4	**4832.3**	351.41	32.46			
	2BH018-BS-030-0	7/31/02	3	4				**1020**	55.8	
	2BH018-BS-050-R	7/31/02	5	6.5	**632.52**	46.41	11.01	**663**	36	
	2BH018-BS-065-R	7/31/02	6.5	8				**19**	1.12	
	2BH018-BS-125-R	7/31/02	12.5	13.75				2.23 J	0.24	
2BH019	2BH019-BS-005-0	7/19/02	0.5	1.2	2.2 J	1.01	2.97	4.19 J	0.44	
	2BH019-BS-020-0	7/19/02	2	2.8				2.25 U		
	2BH019-BS-060-R	7/19/02	6	6.4	2.27 UJ	2.34	4.01	1.31 U		
	2BH019-BS-140-R	7/20/02	14	15				-1.07 U		
2BH020	2BH020-SS-000-0	7/11/02	0	1.5	**132.07**	10.6	6.42	**104**	5.69	
	2BH020-BS-015-0	7/11/02	1.5	3				4.16 U		
	2BH020-BS-050-0	7/11/02	5	6.5	4.43	1.23	2.08	2.59 U		
	2BH020-BS-125-0	7/11/02	12.5	14				2.38 U		
2BH021	2BH021-BS-010-R	8/2/02	1	2.5	1.67 J	1.39	2.34	6.68 U		
	2BH021-BS-025-R	8/2/02	2.5	4				3.12 U		
	2BH021-BS-050-R	8/2/02	5	6.5	0.87 U	1.07	2.64	5.76 U		
	2BH021-BS-125-R	8/2/02	12.5	14				1.62 U		
2BH022	2BH022-BS-005-0	8/6/02	0.5	2	1.73 J	1.16	1.8	1.02 U		
	2BH022-BS-020-0	8/6/02	2	3.5				4.22 U		
	2BH022-BS-050-0	8/6/02	5	6.5	3.5 J	1.88	3.13	3.59 U		
	2BH022-BS-135-0	8/6/02	13.5	15				2.46 U		
2BH023	2BH023-BS-005-0	7/19/02	0.5	2				1.52 U		
	2BH023-BS-020-R	8/12/02	2	3	3.17 J	1.37	1.99	1.70 U		
	2BH023-BS-020-0	7/19/02	2	3.5				1.23 J	0.19	
	2BH023-BS-040-R	8/12/02	4	5.7	1.12 U	1.82	3.35	2.59 U		
	2BH023-BS-100-R	8/12/02	10	10.7				2.20 U		
	2BH023-BS-120-R	8/12/02	12	12.7				0.52 U		

Table 4-9
Total Uranium Results for Soil and Concrete Samples, AOC 2
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2BH024	2BH024-BS-005-0	8/13/02	0.5	1.2	-0.45 U	0.76	2.11	2.04 U		
	2BH024-BS-020-0	8/13/02	2	2.7				2.41 U		
	2BH024-BS-050-0	8/13/02	5	7	2.6 J	1.33	2.11	2.59 U		
	2BH024-CC-060-0	8/14/02	6	6.3	2.4 J	1.56	3.21			
2BH025	2-BH-025-02 (0'-2')	8/18/03	0	2				**19**	7.43	1.28
	2BH025-BS-005-0	8/2/02	0.5	2	**28.72**	3.39	3.61	7.62	0.51	
	2BH025-BS-020-0	8/2/02	2	3.5				**33.5**	1.86	
	2-BH-025-04 (2'-4')	8/18/03	2	4				4.5	2.62	1.26
	2BH025-BS-050-0	8/2/02	5	6.5	11.67	1.92	2.77	5.05	0.36	
	2BH025-BS-135-0	8/2/02	13.5	15				1.44 U		
2BH026	2BH026-BS-005-0	8/16/02	0.5	1.2	8.32	1.39	2.88	5.29	0.37	
	2BH026-BS-020-0	8/16/02	2	2.7	**19.72**	2.51	3.11	**14.1**	0.85	
	2BH026-BS-040-0	8/16/02	4	4.5	**23.18**	3.05	3.8	**15.9**	0.96	
	2BH026-BS-150-0	8/16/02	15	15.5				0.52 U		
2BH027	2BH027-BS-005-R	8/19/02	0.5	1.5	**142.49**	11.17	5.51	**53.7**	2.98	
	2BH027-BS-005-0	7/31/02	0.5	1.5	**134.95**	10.67	5.51	**74.4**	4.12	
	2BH027-BS-020-0	7/31/02	1.5	2.75	**108.65**	8.61	4.68	**167**	9.13	
	2BH027-BS-025-R	8/19/02	2.5	3				8.17	0.542	
	2BH027-BS-045-R	8/19/02	4.5	5.7	**16.62**	2.97	4.24	8.93	0.558	
	2BH027-BS-090-R	8/19/02	9	9.7				3.35 U		
	2BH027-BS-145-R	8/19/02	14.5	15				1.36 U		
2BH028	2BH028-BS-005-0	8/5/02	0.5	2	0.24 U	1.28	2.43	3.38 U		
	2BH028-BS-020-0	8/5/02	2	3.5				1.94 J	0.228	
	2BH028-BS-050-0	8/5/02	5	6.5	0.45 U	1.07	3.1	1.15 U		
	2BH028-BS-135-0	8/5/02	13.5	15				1.52 U		
2BH029	2BH029-BS-005-R	8/5/02	0.5	2	1.86 J	1.03	2.12	1.83 U		
	2BH029-BS-020-R	8/5/02	2	3.5				4.11 U		
	2BH029-BS-050-R	8/5/02	5	6.5	0.24 UJ	0.92	2.73	3.22 U		
	2BH029-BS-130-R	8/5/02	13	14.5				1.52 U		
2BH030	2BH030-BS-005-0	8/1/02	0.5	2	0.76 U	0.89	2.55	1.86	0.17	
	2BH030-BS-020-0	8/1/02	2	3.5				1.23 J	0.20	
	2BH030-BS-050-0	8/1/02	5	6.5	6.75	1.94	3.14	1.18 J	0.17	
	2BH030-BS-130-0	8/1/02	13	14.5				2.07 U		
2BH031	2BH031-BS-005-R	8/13/02	0.5	1.2	-0.51 U	0.91	2.5	1.81 U		
	2BH031-BS-005-0	7/31/02	0.5	2	0.34 U	1.05	1.53	0.60 U		
	2BH031-BS-020-0	7/31/02	2	3.5				0.03 U		
	2BH031-BS-050-R	8/13/02	5	7				2.8 U		
	2BH031-BS-090-R	8/13/02	9	9.7	0.68 UJ	0.9	1.57	3.51 U		
	2BH031-BS-140-R	8/13/02	14	15				1.73 U		
2BH032	2BH032-BS-005-0	8/15/02	0.5	1	0.34 UJ	0.76	2.18	0.94 U		
	2BH032-BS-030-0	8/15/02	3	3.7				4.37 U		
	2BH032-BS-052-0	8/15/02	5.2	5.8				3.85 U		
	2BH032-CC-070-0	8/15/02	7	7.5	-1.33 UJ	0.69	1.87			
	2BH032-CC-075-0	8/15/02	7.5	8	-0.17 UJ	0.77	2.33			
	2BH032-BS-080-0	8/15/02	8	9.25	0.68 UJ	1.18	3.44	7.02 U		
	2BH032-BS-100-0	8/15/02	10	10.75				2.12 U		
2BH033	2BH033-BS-005-0	8/16/02	0.5	2	-0.29 UJ	0.86	2.53	1.23 U		
	2BH033-BS-050-0	8/16/02	5	6.5	-0.13 UJ	1.19	3.26	0.602 U		
	2BH033-BS-095-0	8/16/02	9.5	11				3.48 U		
	2BH033-BS-130-0	8/16/02	13	14.5				2.38 U		
2BH034	2BH034-BS-005-0	8/1/02	0.5	2	-0.18 U	0.82	2.34	1.13 U		

Table 4-9
Total Uranium Results for Soil and Concrete Samples, AOC 2
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2BH034	2BH034-BS-020-0	8/1/02	2	3.5				2.12	0.22	
	2BH034-BS-050-0	8/1/02	5	6.5	4.64 J	1.71	3.15	1.89 J	0.21	
	2BH034-BS-120-0	8/1/02	12	14				4.27 U		
2BH035	2BH035-BS-005-R	8/5/02	0.5	2	0.65 UJ	1.03	2.99	2.54 U		
	2BH035-BS-020-R	8/5/02	2	3.5				2.67 U		
	2BH035-BS-055-R	8/5/02	5.5	7	3 J	1.32	2.49	3.19 U		
	2BH035-BS-135-R	8/5/02	13.5	15				0.995 U		
2BH036	2BH036-BS-005-R	8/1/02	0.5	2	1 U	1.13	2.19	3.06	0.25	
	2BH036-BS-020-R	8/1/02	2	3.5				2.09 J	0.24	
	2BH036-BS-050-R	8/1/02	5	6.5	9.62	2.18	2.98	3.38	0.26	
	2BH036-BS-135-R	8/1/02	13.5	15				3.35 U		
2BH037	2BH037-BS-005-0	8/5/02	0.5	2	3.15 J	1.07	3.16	2.23 J	0.25	
	2BH037-BS-020-0	8/5/02	2	3.5				1.7 J	0.22	
	2BH037-BS-050-0	8/5/02	5	6.5	9.37	1.32	2.45	9.72	0.60	
	2BH037-BS-135-0	8/5/02	13.5	15				1.89 U		
2BH038	2BH038-BS-005-0	7/31/02	0.5	2	**49.02**	4.51	4.06	**26.1**	1.49	
	2BH038-BS-020-0	7/31/02	2	3.5	**16584.4**	1197.63	61.19	**10500**	569	
	2BH038-BS-020-R	8/2/02	2	3.5	**2621.54**	192.86	22.82	**1890**	103	
2BH039	2BH039-BS-005-0	8/6/02	0.5	2	7.83	1.61	2.85	5.89	0.44	
	2BH039-BS-020-0	8/6/02	2	3.5				1.49 U		
	2BH039-BS-050-0	8/6/02	5	6.5	5.84	1.51	2.36	2.33	0.25	
	2BH039-BS-135-0	8/6/02	13.5	15				1.47 U		
2BH040	2BH040-SS-000-0	8/6/02	0	1.5	2.1 J	1.23	2.58	2.3 U		
	2BH040-BS-015-0	8/6/02	1.5	3				0.89 U		
	2BH040-BS-050-0	8/6/02	5	6.5	3.18 J	1.04	2.43	4.11 U		
	2BH040-BS-130-0	8/6/02	13	14.5				1.23 U		
2BH041	2BH041-SS-000-0	8/6/02	0	1.5	0.31 UJ	1.38	2.66	3.85 U		
	2BH041-BS-015-0	8/6/02	1.5	2.5				5.5 U		
	2BH041-BS-050-0	8/6/02	5	6.5	2.16 J	1.76	2.99	2.02 U		
	2BH041-BS-135-0	8/6/02	13.5	15				2.41 U		
2BH042	2BH042-SS-000-0	7/18/02	0	1.5	**263.68**	19.54	8.15	**385**	20.9	
	2BH042-BS-050-0	7/18/02	5	6.5	3.03 J	1.42	2.17	4.71 J		
	2BH042-BS-085-0	7/18/02	8.5	10				1.18 U		
	2BH042-BS-135-0	7/18/02	13.5	15				2.2 U		
2BH043	2BH043-SS-000-0	8/2/02	0	0.5	**237.75**	17.63	6.57	**116**	6.38	
2-MW-01	2-MW-01-B-P-01	9/22/04	4	5	3 U	2.5	3.9			
	2-MW-01-B-P-02	9/22/04	10	11	-0.6 U	2.7	4.7			
	2-MW-01-B-P-03	9/22/04	(blank)	(blank)	**78**	12	6			
2-MW-02	2-MW-02-B-P-01	9/21/04	2	3	**107**	16	13			
	2-MW-02-B-P-02	9/21/04	6	7	**2180**	260	30			
2-MW-03	2-MW-03-B-P-01	9/21/04	2	3	**7760**	910	100			
	2-MW-03-B-P-03	9/21/04	8	9	**3990**	480	130			
	2-MW-03-B-P-02	9/21/04	10	11	**1050**	130	50			
2-MW-04	2-MW-04-B-P-01	9/8/04	8	8.5	4.9 U	4.9	7.9			
	2-MW-04-B-P-02	9/10/04	8	9	1.3 U	1.9	3.1			
2-MW-05	2-MW-05-B-P-01	9/20/04	4	5	**377**	46	11			
	2-MW-05-B-P-02	9/20/04	8	9	5.8	3.2	4.9			
2-MW-06	2-MW-06-B-P-01	9/15/04	2	3	5.7 U	5	8			
2-MW-12	2-MW-12-B-P-01	9/16/04	4	5	9.5	5.5	8.5			
	2-MW-12-B-P-02	9/16/04	6	7	1.2 U	2.1	3.5			
2-MW-15	2-MW-15-B-P-01	9/22/04	2	3	7.3	4	6.2			

Table 4-9
Total Uranium Results for Soil and Concrete Samples, AOC 2
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2-MW-16	2-MW-16-B-P-01	9/23/04	2	3	2 U	3.1	5.1			
	2-MW-16-B-P-02	9/23/04	6	7	3.4 U	3.2	5.1			
2-MW-19	2-MW-19-B-P-01	8/23/05	4	4.5	0 U	1.7	3			
	2-MW-19-B-P-02	8/23/05	6	6.5	3.3 U	2.3	3.5			
2-MW-20	2-MW-20-B-P-01	7/18/05	1	1.5	**220**	29	16			
	2-MW-20-B-P-02	7/18/05	2	2.5	5.8 U	4.7	7.5			
2-MW-23	2-MW-23-B-P-01	7/18/05	2	2.5	3.3 U	3.3	5.4			
	2-MW-23-B-P-02	7/18/05	10.5	11	3.6 U	2.8	4.5			
2-MW-24	2-MW-24-B-P-01	7/17/05	2	2.5	-0.1 U	1.8	3.3			
	2-MW-24-B-P-02	7/17/05	6.5	7	0.7 U	1.8	3			
2-MW-25	2-MW-25-B-P-05	11/13/05	5	6	**803**	96	16			
	2-MW-25-B-P-18	11/13/05	18	19	2.3 U	1.9	2.9			
	2-MW-25-B-P-24	11/14/05	24	25	9.5	4.8	7.2			
	2-MW-25-B-P-31	11/14/05	31	32	1.5 U	3.3	5.4			
2-MW-26	2-MW-26-B-P-01	7/17/05	1.5	2	0.7 U	1.6	2.7			
	2-MW-26-B-P-02	7/17/05	9	9.5	1.2 U	1.6	2.7			

					Offsite Alpha Spectroscopy		
Radionuclide					Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
2-SB-06	2-SB-06-SS-P-00	6/26/07	0	1	6.5	1.3	0.1
	2-SB-06-BS-P-02	6/26/07	2	3	**309**	46	0
2-SB-07	2-SB-07-SS-P-00	6/26/07	0	1	**72**	12	0
	2-SB-07-BS-P-01	6/26/07	1	2	**800 M3**	120	0
2-SB-08	2-SB-08-SS-P-00	6/26/07	0	1	3.41	0.78	0.06
	2-SB-08-BS-P-01	6/26/07	1	2	2.98	0.72	0.11
2-SB-09	2-SB-09-SS-P-00	6/27/07	0	1	**366 M3**	61	1
	2-SB-09-BS-P-01	6/27/07	1	2	**262 Y2**	46	0
2-SB-10	2-SB-10-SS-P-00	6/27/07	0	1	**42.4**	7	0.1
	2-SB-10-BS-P-02	6/27/07	2	3	**13700** M3	2500	0

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
pCi/g = Picocuries per gram
TPU = Total Propagated Uncertainty
J = Result is an estimated value
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits
Shading indicates sample results exceeding the Investigative Sscreening Value of 14 pCi/g
No onsite laboratory was used during monitoring well installation (2004) or additional sampling (2007)

Table 4-10
Radiological Isotopic Results for Soil and Concrete Samples, AOC 2

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	RA-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
2BH001	2BH001-BS-005-0	7/19/02	0.5	2									2.36		1.11	0.74									0.04	U	0.18	0.3				
	2BH001-BS-050-0	7/19/02	5	6.5									0.34	UJ	0.68	1.07									0.09	U	0.23	0.42				
2BH002	2BH002-BS-005-0	7/19/02	0.5	2									0.53	UJ	1.37	1.17									0.2	UJ	0.25	0.44				
	2BH002-BS-050-0	7/19/02	5	6.5									0.62	J	0.6	0.72									0.01	U	0.16	0.28				
2BH003	2BH003-BS-050-0	7/19/02	5	6.5									1.82	UJ	1.94	1.45									0.18	U	0.32	0.55				
	2BH003-SS-000-0	7/19/02	0	1.5									1.67	J	0.74	1.07									0.11	U	0.25	0.45				
2BH004	2BH004-SS-000-0	7/26/02	0	1.5									5.68		1.52	1.09									0.55	J	0.33	0.38				
	2BH004-BS-050-0	7/26/02	5	6.5									0.87	UJ	1.01	1.19									0.12	U	0.24	0.42				
	2BH004-BS-085-0	7/26/02	8.5	10					0.19	J	0.07	0.08																				
2BH005	2BH005-BS-005-0	7/22/02	0.5	2									1.18	J	0.78	0.7									0.11	U	0.15	0.28				
	2BH005-BS-050-0	7/22/02	5	6.5									-0.16	UJ	0.67	1.18									-0.19	U	0.22	0.35				
2BH006	2BH006-BS-005-0	7/22/02	0.5	2									0.12	UJ	0.67	0.8									0.09	U	0.17	0.32				
	2BH006-BS-050-0	7/22/02	8.5	10					0.79	J	0.17	0.08																				
	2BH006-BS-070-0	7/22/02	7	8.5									0.84	UJ	1.01	0.93									0.24	UJ	0.27	0.35				
2BH007	2BH007-BS-005-0	7/22/02	0.5	2									0.39	UJ	0.64	1.17									-0.12	U	0.22	0.35				
	2BH007-BS-050-0	7/22/02	5	6.5									0.14	UJ	0.71	0.75									-0.01	U	0.17	0.3				
2BH008	2BH008-BS-005-0	7/19/02	0.5	2									0.75	UJ	0.87	0.7									0.05	U	0.17	0.29				
	2BH008-BS-050-0	7/19/02	5	6.5									1.22	J	0.9	0.95									0.02	U	0.2	0.35				
2BH009	2BH009-BS-005-0	7/26/02	0.5	2									2.26		1.03	0.95									0.2	UJ	0.27	0.35				
	2BH009-BS-030-0	7/26/02	3	4.5					0.58		0.13	0.07																				
	2BH009-BS-050-0	7/26/02	5	6.5									0.56	UJ	0.73	0.77									0.13	U	0.18	0.31				
2BH010	2BH010-BS-005-0	7/26/02	0.5	2									57.61		6.79	2.76									4.18		1.26	0.66				
	2BH010-BS-050-0	7/26/02	5	6.5									1.2	J	0.86	1.25									-0.02	U	0.3	0.53				
2BH011	2BH011-SS-000-0	7/11/02	0	1.5									2.66		0.83	0.82									0.1	UJ	0.2	0.28				
	2BH011-BS-050-0	7/11/02	5	6									0.13	U	0.34	0.62									0.02	U	0.12	0.21				
2BH012	2BH012-BS-005-0	8/8/02	0.5	2									1.85		0.83	0.99									0.1	UJ	0.35	0.41				
	2BH012-BS-050-0	8/8/02	5	6.5									0.36	UJ	0.9	1.16									0.18	U	0.28	0.48				
	2BH012-BS-110-0	8/8/02	11	12.5					0.278	J	0.08	0.08																				
2BH013	2BH013-BS-005-R	8/7/02	0.5	2									0.76	UJ	1.04	1.25									0.1	U	0.31	0.51				
	2BH013-BS-050-R	8/7/02	5	6.5									0.36	UJ	0.74	0.77									0.03	U	0.16	0.29				
2BH014	2BH014-BS-005-R	7/27/02	0.5	2									-0.02	UJ	0.57	1.01									0.14	UJ	0.17	0.29				
	2BH014-BS-050-0	7/24/02	5	6.5									1.18	J	1.1	0.92									0.21	UJ	0.34	0.36				
2BH015	2BH015-BS-005-R	7/20/02	0.5	1.3									0.37	UJ	0.5	0.77									0.02	U	0.17	0.29				
	2BH015-BS-080-R	7/20/02	8	8.8									0.7	UJ	0.96	1.27									0.08	U	0.35	0.58				
	2BH015-CC-065-R	7/20/02	6.5	7.85									1.62	J	1.2	1.17									0.34	UJ	0.36	0.48				
2BH016	2BH016-BS-005-0	7/19/02	0.5	2									0.77	J	0.72	0.78									0	U	0.19	0.34				
	2BH016-BS-050-0	7/19/02	5	6.5									1.57	J	0.83	0.93									-0.11	U	0.2	0.34				
2BH017	2BH017-BS-005-0	8/2/02	0.5	2									1.26	J	0.69	1.3									0	U	0.2	0.35				
	2BH017-BS-050-0	8/2/02	5	6.5									0.27	UJ	1.08	1.26									0	U	0.28	0.47				
2BH018	2BH018 (0-2)	8/13/03	0	2					32.3		5.4	0.1																				
	2BH018-BS-005-0	7/31/02	0.5	1.75									10.34		1.67	0.99									0.91		0.27	0.29				
	2BH018-BS-025-0	7/31/02	2.5	4									2337		248.4	14.48	2364	L	718.2	39.81	72.49	J	59.79	49.12	158.3		9.03	3.5	2389	L	724.7	39.64
	2BH018-BS-050-R	7/31/02	5	6.5									305.9		32.8	4.93	263.8		55.67	2.54	12.89		6.4	1.84	20.72		1.49	1.15	282.3		59.19	2.97
2BH019	2BH019-BS-005-0	7/19/02	0.5	1.2									1.12	J	0.7	1.31									-0.04	U	0.21	0.35				
	2BH019-BS-060-R	7/19/02	6	6.4									0.98	UJ	1.63	1.65									0.32	UJ	0.41	0.71				
2BH020	2BH020-SS-000-0	7/11/02	0	1.5									63.35		7.48	2.86									5.37		0.66	0.7				
	2BH020-BS-050-0	7/11/02	5	6.5									2.29		0.86	0.87									-0.16	U	0.22	0.35				
2BH021	2BH021-BS-010-R	8/2/02	1	2.5									0.75	UJ	0.97	0.98									0.17	U	0.21	0.38				
	2BH021-BS-050-R	8/2/02	5	6.5									0.53	UJ	0.73	1.09									-0.18	U	0.29	0.46				
2BH022	2BH022-BS-005-0	8/6/02	0.5	2									0.89	J	0.81	0.75									-0.06	U	0.16	0.29				
	2BH022-BS-050-0	8/6/02	5	6.5									1.68	J	1.31	1.33									0.14	U	0.28	0.48				
2BH023	2BH023-BS-020-R	8/12/02	2	3									1.56	J	0.96	0.83									0.06	U	0.18	0.32				
	2BH023-BS-040-R	8/12/02	4	5.7									0.53	UJ	1.27	1.39									0.07	U	0.34	0.57				

Table 4-10
Radiological Isotopic Results for Soil and Concrete Samples, AOC 2
(cont.)

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	RA-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
2BH024	2BH024-BS-005-0	8/13/02	0.5	1.2									-0.21	U	0.52	0.89									-0.02	U	0.2	0.33				
	2BH024-BS-050-0	8/13/02	5	7									1.26	J	0.93	0.88									0.08	U	0.19	0.34				
	2BH024-CC-060-0	8/14/02	6	6.3									1.25	J	1.08	1.35									-0.1	U	0.31	0.51				
2BH025	2-BH-025-02	8/18/03	0	2					0.98		0.19	0.07																				
	2-BH-025-04	8/18/03	2	4					0.44		0.1	0.07																				
	2BH025-BS-005-0	8/2/02	0.5	2									13.96		2.38	1.58									0.8	J	0.41	0.46				
	2BH025-BS-050-0	8/2/02	5	6.5									5.69		1.34	1.18									0.29	UJ	0.3	0.42				
2BH026	2BH026-BS-005-0	8/16/02	0.5	1.2									4.06		0.96	1.23									0.2	UJ	0.31	0.42				
	2BH026-BS-020-0	8/16/02	2	2.7									9.69		1.75	1.31									0.35	UJ	0.43	0.5				
	2BH026-BS-040-0	8/16/02	4	4.5									11.38		2.13	1.57									0.42	UJ	0.47	0.65				
2BH027	2BH027-BS-005-0	7/31/02	0.5	1.5									65.19		7.53	2.45									4.57		0.57	0.62				
	2BH027-BS-005-R	7/31/02	0.5	1.5									69.03		7.89	2.46									4.43		0.56	0.59				
	2BH027-BS-020-0	7/31/02	1.5	2.75									52.34		6.08	2.08									3.97		0.47	0.53				
	2BH027-BS-045-R	7/31/02	4.5	5.7									8.04		2.04	1.76									0.55	UJ	0.66	0.72				
2BH028	2BH028-BS-005-0	8/5/02	0.5	2									0.08	U	0.89	1.03									0.07	U	0.22	0.38				
	2BH028-BS-050-0	8/5/02	5	6.5									0.27	U	0.74	1.35									-0.09	U	0.24	0.39				
2BH029	2BH029-BS-005-R	8/5/02	0.5	2									0.96	J	0.72	0.89									-0.07	U	0.2	0.34				
	2BH029-BS-050-R	8/5/02	5	6.5									0.11	U	0.63	1.18									0.02	U	0.21	0.36				
2BH030	2BH030-BS-005-0	8/1/02	0.5	2									0.47	U	0.61	1.09									-0.19	U	0.24	0.37				
	2BH030-BS-050-0	8/1/02	5	6.5									3.41		1.36	1.34									-0.07	U	0.27	0.46				
2BH031	2BH031-BS-005-0	7/31/02	0.5	2									0.19	UJ	0.73	0.64									-0.04	U	0.15	0.26				
	2BH031-BS-005-R	8/13/02	0.5	1.2									-0.31	U	0.62	1.06									0.1	U	0.23	0.39				
	2BH031-BS-090-R	8/13/02	9	9.7									0.34	UJ	0.63	0.66									0	U	0.15	0.26				
2BH032	2BH032-BS-005-0	8/15/02	0.5	1									0.2	U	0.52	0.94									-0.06	U	0.2	0.3				
	2BH032-BS-080-0	8/15/02	8	9.25									0.36	U	0.81	1.49									-0.04	U	0.27	0.46				
	2BH032-CC-070-0	8/15/02	7	7.5									-0.69	U	0.47	0.77									0.06	U	0.19	0.33				
	2BH032-CC-075-0	8/15/02	7.5	8									-0.15	U	0.53	1.01									0.13	U	0.18	0.32				
2BH033	2BH033-BS-005-0	8/16/02	0.5	2									-0.03	U	0.59	1.1									-0.23	U	0.21	0.33				
	2BH033-BS-050-0	8/16/02	5	6.5									-0.06	U	0.81	1.39									-0.01	U	0.3	0.49				
2BH034	2BH034-BS-005-0	8/1/02	0.5	2									-0.08	U	0.57	1.02									-0.03	U	0.17	0.29				
	2BH034-BS-050-0	8/1/02	5	6.5									2.27	J	1.2	1.33									0.11	U	0.28	0.49				
	2BH034-BS-075-0	8/1/02	7.5	9					1.1		0.22	0.08																				
2BH035	2BH035-BS-005-R	8/5/02	0.5	2									0.23	U	0.7	1.29									0.18	UJ	0.29	0.41				
	2BH035-BS-055-R	8/5/02	5.5	7									1.42	J	0.9	1.05									0.16	UJ	0.34	0.39				
2BH036	2BH036-BS-005-R	8/1/02	0.5	2									0.45	UJ	0.79	0.92									0.1	U	0.21	0.36				
	2BH036-BS-050-R	8/1/02	5	6.5									4.7		1.53	1.25									0.22	UJ	0.27	0.47				
2BH037	2BH037-BS-005-0	8/5/02	0.5	2									1.54	J	0.74	1.38									0.08	U	0.24	0.39				
	2BH037-BS-050-0	8/5/02	5	6.5									4.59		0.91	1.03									0.19	UJ	0.32	0.39				
	2BH037-BS-120-0	8/5/02	12	13.5					0.346		0.096	0.082																				
2BH038	2-BH-018 (500ML)	8/5/02	0	2					15	J	2.5	0.1																				
	2BH038-BS-005-0	7/31/02	0.5	2									24.21		3.18	1.78									0.6	J	0.4	0.51				
	2BH038-BS-020-0	7/31/02	2	3.5									7969		846.3	26.69	9459		2526	232.4	503.1		301.9	199.7	646.4		43.3	7.81	9543		2545	220.2
	2BH038-BS-020-R	7/31/02	2	3.5									1266		136.3	10.05	1674		421.8	32.48	78.55		47.66	28.33	89.54		6.38	2.72	1618		408.7	32.34
2BH039	2BH039-BS-005-0	8/6/02	0.5	2									3.89		1.13	1.21									0.05	U	0.25	0.43				
	2BH039-BS-050-0	8/6/02	5	6.5									2.91		1.06	0.99									0.02	U	0.22	0.38				
2BH040	2BH040-SS-000-0	8/6/02	0	1.5									1.1	J	0.85	1.08									-0.1	U	0.25	0.42				
	2BH040-BS-050-0	8/6/02	5	6.5									1.57	J	0.72	1.02									0.03	U	0.22	0.39				
2BH041	2BH041-SS-000-0	8/6/02	0	1.5									0.11	U	0.96	1.13									0.09	U	0.24	0.41				
	2BH041-BS-050-0	8/6/02	5	6.5									0.97	UJ	1.22	1.26									0.21	UJ	0.36	0.48				
2BH042	2BH042-SS-000-0	7/18/02	0	1.5									126.3		13.8	3.56									11.08		1.04	1.03				
	2BH042-BS-050-0	7/18/02	5	6.5									1.49	J	1.00	0.91									0.05	U	0.20	0.33				
2BH043	2BH043-SS-000-0	7/18/02	0	0.5									114.5		12.45	2.9	103.5		19.77	0.76	3.1		2.12	0.93	8.75		0.84	0.76	110.5		20.9	1.29

Table 4-10
Radiological Isotopic Results for Soil and Concrete Samples, AOC 2
(cont.)

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	RA-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
2-MW-01	2-MW-01-B-P-01	9/22/04	4	5									1.4	U	1.2	1.9									0.19	U	0.33	0.55				
	2-MW-01-B-P-02	9/22/04	10	11									-0.3	U	1.3	2.3									-0.14	U	0.28	0.49				
	2-MW-01-B-P-03	9/22/04	(blank)	(blank)									37.9		5.7	3									1.97		0.64	1.03				
2-MW-02	2-MW-02-B-P-01	9/21/04	2	3									52.5		8	6.6									2.72		0.49	0.61				
	2-MW-02-B-P-02	9/21/04	6	7									1070		130	10									58		7	2.6				
2-MW-03	2-MW-03-B-P-01	9/21/04	2	3									3790		450	50									225		26	5				
	2-MW-03-B-P-02	9/21/04	10	11									513		66	26									28		3.6	1.8				
	2-MW-03-B-P-03	9/21/04	8	9									1950		230	70									109		13	4				
2-MW-04	2-MW-04-B-P-01	9/8/04	8	8.5									2.4	U	2.4	3.9									0.33	U	0.23	0.45				
	2-MW-04-B-P-02	9/8/04	8	9									0.64	U	0.93	1.53									-0.03	U	0.2	0.37				
2-MW-05	2-MW-05-B-P-01	9/20/04	4	5									184		22	6									10.9		1.4	0.9				
	2-MW-05-B-P-02	9/20/04	8	9									2.8		1.6	2.4									0.19	U	0.31	0.52				
2-MW-12	2-MW-12-B-P-01	9/16/04	4	5									4.6		2.7	4.1									0.35	U	0.2	0.36				
	2-MW-12-B-P-02	9/16/04	6	7									0.6	U	1	1.7									-0.14	U	0.28	0.5				
2-MW-15	2-MW-15-B-P-01	9/22/04	2	3									3.6		1.9	3									0.3	U	0.21	0.32				
2-MW-16	2-MW-16-B-P-01	9/23/04	2	3									1	U	1.5	2.5									0.23	U	0.29	0.47				
	2-MW-16-B-P-02	9/23/04	6	7									1.7	U	1.6	2.5									-0.06	U	0.21	0.36				
2-MW-19	2-MW-19-B-P-01	8/23/05	4	4.5	0.64		0.2	0.34					-0.01	U	0.84	1.48									0.04	U	0.26	0.46				
	2-MW-19-B-P-02	8/23/05	6	6.5	1.29		0.24	0.36					1.6	U	1.1	1.7									0.04	U	0.29	0.51				
2-MW-20	2-MW-20-B-P-01	7/18/05	1	1.5	1.4		0.32	0.45					108		14	8									5.38		0.81	0.85				
	2-MW-20-B-P-02	7/18/05	2	2.5	1.82		0.37	0.53					2.8	U	2.3	3.7									0	U	0.23	0.4				
2-MW-23	2-MW-23-B-P-01	7/18/05	2	2.5	2.87		0.52	0.67					1.6	U	1.6	2.6									0.12	U	0.51	0.88				
	2-MW-23-B-P-02	7/18/05	10.5	11	1.36		0.32	0.54					1.8	U	1.4	2.2									0.07	U	0.33	0.58				
2-MW-24	2-MW-24-B-P-01	7/17/05	2	2.5	0.52		0.19	0.36					-0.07	U	0.9	1.6									0.08	U	0.31	0.55				
	2-MW-24-B-P-02	7/17/05	6.5	7	1.15		0.28	0.46					0.33	U	0.86	1.47									-0.12	U	0.27	0.5				
2-MW-25	2-MW-25-B-P-05	11/13/05	5	6	0.57		0.27	0.56					392		47	8									21.9		2.8	1.8				
	2-MW-25-B-P-18	11/13/05	18	19	0.5		0.23	0.45					1.14	U	0.91	1.43									0.08	U	0.3	0.52				
	2-MW-25-B-P-24	11/13/05	24	25	2.72		0.49	0.61					4.7		2.3	3.5									-0.09	U	0.51	0.91				
	2-MW-25-B-P-31	11/13/05	31	32	1.54		0.32	0.45					0.7	U	1.6	2.7									0.14	U	0.38	0.64				
2-MW-26	2-MW-26-B-P-01	7/17/05	1.5	2	0.44	U	0.24	0.48					0.34	U	0.76	1.3									-0.11	U	0.25	0.48				
	2-MW-26-B-P-02	7/17/05	9	9.5	1.12		0.28	0.47					0.56	U	0.79	1.3									0.03	U	0.3	0.53				
2-SB-06	2-SB-06-SS-P-00	6/26/07	0	1	0.37	LT,T1	0.16	0.28	0.283	M3	0.10	0.10	2.3	U,M	3.4	5.7	2.95		0.58	0.05	0.14		0.081	0.03	0.07	U	0.26	0.46	3.19		0.62	0.05
	2-SB-06-BS-P-02	6/26/07	2	3	1.3	M3,G	0.31	0.54	1.06		0.19	0.07	150	M3,G	19	5	150		23	0	6.60	M3	1.1	0.1	7.9	G	1.2	1.2	151		23	0
2-SB-07	2-SB-07-SS-P-00	6/26/07	0	1	0.56	G	0.19	0.36	0.91		0.17	0.07	38.1	M3,G	9.1	9.9	34.1	M3	5.7	0.2	1.64	M3	0.41	0.1	2.39	G	0.57	0.87	35.3		5.9	0.1
	2-SB-07-BS-P-01	6/26/07	1	2	0.63	M3,G	0.25	0.51	0.94		0.18	0.08	412	M3,G	56	34	385	M3	58	0	17.90	M3	3	0.3	20.5	G	2.8	1.9	394	M3	59	0
2-SB-08	2-SB-08-SS-P-00	6/26/07	0	1	0.43	LT,G,T1	0.2	0.33	0.46		0.1	0.07	2.4	U,M,G	3.7	6.2	1.66		0.38	0.07	0.04	LT	0.05	0.04	-0.03	U,G	0.37	0.66	1.67		0.38	0.03
	2-SB-08-BS-P-01	6/26/07	1	2	0.75	G	0.21	0.37	0.57		0.12	0.07	1.4	U,G	1.3	2.2	1.56		0.37	0.07	0.07	LT	0.06	0.06	0.26	U,G	0.3	0.49	1.46		0.35	0.05
2-SB-09	2-SB-09-SS-P-00	6/27/07	0	1	1.51	G	0.29	0.39	6.5		1.1	0.1	135	M3,G	20	12	174	M3	29	0	7.8	M3	1.8	0.3	6.5	G	1	1.1	179	M3	30	0
	2-SB-09-BS-P-01	6/27/07	1	2	0.81	G	0.23	0.46	0.7		0.13	0.05	133	M3,G	17	5	123	Y2	22	0	5.6	Y2	1.1	0	7	G	1.1	0.9	128	Y2	23	0
2-SB-10	2-SB-10-SS-P-00	6/27/07	0	1	0.46	LT	0.16	0.32	1.03		0.19	0.06	17.6	M3	6	7.6	20.4		3.4	0.1	1.15		0.26	0.05	1.18	LT	0.46	0.72	20.7		3.4	0.1
	2-SB-10-BS-P-02	6/27/07	2	3	2.24	M3	0.44	0.79	6.9	M3	1.4	0.8	4300	M3	500	50	6500	M3	1200	0	301	M3	76	7	254	M3	30	4	6700	M3	1200	0

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
pCi/g = Picocuries per gram
TPU = Total Propagated Uncertainty
G = Sample density differs by more than 15% of LCS density: sample results may be biased
J = Result is an estimated value
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
M3 = The requested MDC was not met, byt the reported activity is greater than the reported MDC.
TI = Nuclide identification is tentative
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits

Table 4-11
Metals Exceeding Preliminary Remediation Goals in Soil Samples, AOC 2

		Analyte	ARSENIC		CHROMIUM		COPPER		IRON		LEAD	
		NJDEP SCC (mg/kg)	20		NA		600		NA		400	
		Region 6 PRG (mg/kg)	**0.39**		**30.1**		**2905**		**54750**		**400**	
Sample ID	**Sample Date**	**Start Depth/ End Depth (ft bgs)**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**
2BH004-BS-015-0	7/26/02	1.5 / 2.5	1.2		30.8							
2BH010-BS-005-R	7/29/02	0.5 / 1.5	5.9									
2BH013-BS-005-0	8/8/02	0.5 / 2	1.9									
2BH018-BS-015-R	7/31/02	1.5 / 2.5	3.2									
2BH020-SS-000-0	7/11/02	0 / 1.5	5									
2-SB-06-BS-P-02	7/26/07	2 / 3	1.7									
2-SB-06-SS-P-00	7/26/07	0 / 1	20									
2-SB-07-BS-P-01	7/26/07	1 / 2	1.7						58000			
2-SB-07-SS-P-00	7/26/07	0 / 1	7.3		57						820	
2-SB-08-BS-P-01	7/26/07	1 / 2	2.8									
2-SB-08-SS-P-00	7/26/07	0 / 1			55	N						
2-SB-09-BS-P-01	7/27/07	1 / 2	4.9				6400					
2-SB-09-SS-P-00	7/27/07	0 / 1	2.8									
2-SB-10-BS-P-02	7/27/07	2 / 3	2.5									
2-SB-10-SS-P-00	7/27/07	0 / 1	1.1									

Notes:

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
PRG = Preliminary Remediation Goal
NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria
N = Matrix spike recovery outside control limits

Table 4-12
VOCs and SVOCs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 2

Sample ID			2BH004-BS-015-0	2BH010-BS-005-R	2BH020-SS-000-0	2-SB-06-BS-P-02	2-SB-07-BS-P-01	2-SB-07-SS-P-00	2-SB-08-BS-P-01	2-SB-08-SS-P-00	2-SB-09-BS-P-01	2-SB-10-SS-P-00
Sample Date			7/26/02	7/29/02	7/11/02	7/26/07	7/26/07	7/26/07	7/26/07	7/26/07	7/27/07	7/27/07
StartDepth / EndDepth (ft bgs)			1.5 / 2.5	0.5 / 1.5	0 / 1.5	2 / 3	1 / 2	0 / 1	1 / 2	0 / 1	1 / 2	0 / 1
	NJDEP SCC (ug/kg)	**Reg 6 PRG (ug/kg)**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**	**Result (ug/kg)** **Flag**
SVOC												
1,4-DICHLOROBENZENE	570000	**3200**	390000 E									
VOC												
BENZENE	3000	**656**	930									

Notes:

ft bgs = Feet below ground surface
ug/kg = micrograms per kilogram
PRG = Preliminary Remediation Goal
NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria
E = Analyte concentration exceeds upper level of concentration range
J = Result is an estimated value
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table 4-13
PAHs and PCBs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 2

Sample ID			2BH004-BS-015-0		2BH018-BS-015-R		2-SB-06-BS-P-02		2-SB-06-SS-P-00		2-SB-07-BS-P-01		2-SB-07-SS-P-00		2-SB-08-BS-P-01		2-SB-08-SS-P-00		2-SB-09-BS-P-01		2-SB-09-SS-P-00		2-SB-10-SS-P-00	
Sample Date			7/26/02		7/31/02		7/26/07		7/26/07		7/26/07		7/26/07		7/26/07		7/26/07		7/27/07		7/27/07		7/27/07	
StartDepth / EndDepth (ft bgs)			1.5 / 2.5		1.5 / 2.5		2 / 3		0 / 1		1 / 2		0 / 1		1 / 2		0 / 1		1 / 2		0 / 1		0 / 1	
	NJDEP SCC (ug/kg)	**Reg 6 PRG (ug/kg)**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**	**Result (ug/kg)**	**Flag**
PAHs																								
BENZO(A)ANTHRACENE	900	**148**					2800						590		670		750		210	B				
BENZO(A)PYRENE	660	**14.8**					4300		21		79		940		930		570		270				86	
BENZO(B)FLUORANTHENE	900	**148**					4300				220		2400		1000		820		420				190	
DIBENZO(A,H)ANTHRACENE	660	**14.8**					640				25		210		220		130		54				23	
INDENO(1,2,3-CD)PYRENE	900	**148**					1900	B					610	B	610	B	320	B	150					
PCBs																								
AROCLOR-1221	NA	**222**	18000																					
AROCLOR-1260	NA	**222**			990				5900				410								4400		1900	
Pesticides																								
ALPHA-BHC	NA	**90.2**	260																					

Notes:

ft bgs = Feet below ground surface
ug/kg = micrograms per kilogram
PRG = Preliminary Remediation Goal
NJDEP SCC = New Jersey Department of Environmental Protection Soil Cleanup Criteria
B = Analyte is detected in blank as well as sample
E = Analyte concentration exceeds upper level of concentration range

Table 4-14
Radiological Field Instrument Readings, Fill Material Test Pit Program, AOC 2

Location	Field Sample ID	Sample Date	Depth (ft. bgs)		Direct Field Reading	
			Top	Bottom	Beta Ludlum 2360 (dpm/100 cm^2)	Alpha Ludlum 2360 (dpm/100 cm^2)
2TP001	2TP001-MISC DEBRIS	8/26/02	0	6.5	<MDA	<MDA
2TP001	2TP001-SMALL WOOD	8/26/02	0	6.5	5,638	26.2
2TP001	2TP001-WOODBOARD	8/26/02	0	6.5	7,780	41.5
2TP002	2TP002-CONCRETE SLAB	8/26/02	0	6.5	5,638	41.5

Notes:

ft bgs = Feet below ground surface

MDA = Minimum Detectable Activity

dpm = disintegrations per minute

cm^2 = centimeters squared

Table 4-15
Isotopic and Total Uranium in Groundwater Geoprobe Samples, AOC 1

		U-234					U-235 [(a)]					U-238					Uranium (Total)						
		Filtered			Unfiltered		Filtered			Unfiltered		Filtered			Unfiltered		Filtered				Unfiltered		
Sample ID	Sample Date	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]
1BH001-GW-001-0	7/12/02	0.31	J	0.26	1.09		0.4	0.12	U	0.18	0	J	0	0.1	UJ	0.15	1.06		0.39	0.53	J	0.79	0.35	2.15		3.2	0.56
								-11.66	*U*	*17.39*	*-10.38*	*U*	*17.35*													
1BH002-GW-001-0	7/10/02	1.1		0.56	19.67		5.64	0.14	UJ	0.2	1.28	J	0.92	0.61	J	0.4	25.38		7.03	1.86		2.79	0.72	46.33		69.5	9.06
								-69300	*U*	*6529*	*6*	*U*	*19.71*													
1BH003-GW-001-0	7/10/02	1.15		0.48	1.06		0.38	0.09	U	0.15	0.2	J	0.16	0.81		0.4	1.32		0.43	2.05		3.07	0.64	2.58		3.9	0.6
								30.73	*J*	*28.04*	*-4.77*	*U*	*17.03*													
1BH004-GW-001-0	7/10/02	0.42	J	0.31	7.33		2.29	0.06	UJ	0.12	0.41	UJ	0.46	0.52	J	0.35	10.61		3.04	1	J	1.50	0.48	18.35		27.5	3.83
								-2.28	*U*	*16.79*	*9.79*	*U*	*17.43*													
1BH006-GW-001-0	7/12/02	0.12	UJ	0.16	1.99		0.6	0.07	UJ	0.14	0.04	UJ	0.08	0.05	U	0.12	1.88		0.58	0.23	U	0.34	0.25	3.91		5.9	0.84
								3.71	*U*	*22.18*	*1.25*	*U*	*22.26*													
1BH007-GW-001-0	7/1/02	0.11	UJ	0.16	0.72	J	0.32	0	J	0	0.03	U	0.08	0.16	UJ	0.2	0.57	J	0.28	0.27	J	0.40	0.25	1.33	J	2.0	0.43
								-12.67	*U*	*21.69*	*-17.55*	*U*	*19.91*													
1BH011-GW-001-0	7/10/02				2.57		0.66				0.03	U	0.07				2.29		0.61					4.89		7.3	0.9
											-3.54	*U*	*19.91*													
1BH012-GW-001-0	6/28/02	0.12	UJ	0.12	1.03	J	0.39	-0.01	U	0.01	-0.01	U	0.01	0.15	J	0.14	0.47		0.25	0.26	J	0.39	0.19	1.49		2.2	0.47
								-10.62	*U*	*18.18*	*-9.29*	*U*	*16.87*													
1BH013-GW-001-0	6/28/02	0.13	UJ	0.18	0.06	UJ	0.08	0.06	U	0.16	0	J	0	0.06	UJ	0.13	0.16	J		0.25	U	0.37	0.27	0.21	J	0.3	0.16
								5.72	*U*	*19.54*	*-6.59*	*U*	*19.91*													
1BH014-GW-001-0	6/28/02	0.34	J	0.32	0.22	J	0.16	0	J	0	-0.01	U	0.01	0.42	J	0.35	0.14	J	0.13	0.76	J	1.14	0.48	0.35	J	0.5	0.21
								64.13		*21.36*	*1.45*	*U*	*17.39*													
1BH016-GW-001-0	7/8/02	0.07	U	0.12	0.18	UJ	0.19	0	J	0	0	J	0	0	U	0.15	0.21	J	0.18	0.07	U	0.10	0.19	0.39	J	0.6	0.26
								2.27	*U*	*27.32*	*-18.13*	*UJ*	*17.98*													
1BH017-GW-001-0	7/8/02	3.97		1.08	7.16		1.62	0.15	UJ	0.18	0.8		0.42	3.88		1.06	12.71		2.59	8		11.99	1.52	20.67		31.0	3.08
								-6.62	*U*	*20.32*	*19.41*	*UJ*	*20.11*													
1BH018-GW-001-0	7/1/02	0.17	J	0.14	0.02	UJ	0.06	-0.01	U	0.01	-0.01	U	0.01	0.03	UJ	0.06	0.06	UJ	0.09	0.19	J	0.28	0.16	0.07	UJ	0.1	0.11
								-12.68	*U*	*19.09*	*-5.9*	*U*	*21.01*													
1BH019-GW-001-0	6/28/02	0.07	UJ	0.11	0.51	J	0.27	0.14	UJ	0.16	-0.01	U	0.01	0.15	UJ	0.15	0.16	J	0.14	0.36	J	0.54	0.24	0.66		1.0	0.31
								-0.7	*U*	*17.35*	*7.06*	*U*	*17.63*													
1BH020-GW-001-0	6/28/02	0.53	J	0.28	1.29	J	0.42	0.04	UJ	0.08	0.16	J	0.14	0.49		0.27	1.2		0.4	1.05		1.57	0.39	2.64		4.0	0.59
								9.5	*U*	*20.15*	*-11.77*	*U*	*18.5*													
1BH021-GW-001-0	6/28/02		UJ	0.15	0.18	J	0.15	-0.01	U	0.02	0.08	UJ	0.11	-0.01	U	0.01	0.24	J	0.18	0.13	U	0.19	0.15	0.5	J	0.7	0.26
								-4.24	*U*	*17.02*	*14.19*	*UJ*	*20.81*													
1BH023-GW-001-0	7/9/02	-0.03	U	0.12	1.46		0.48	-0.02	U	0.03	0.02	UJ	0.07	0.16	U	0.23	1		0.38	0.11	U	0.16	0.26	2.48		3.7	0.61
								8.92	*UJ*	*19.6*	*3.1*	*UJ*	*18*													
1BH024-GW-001-0	7/9/02	-0.03	U	0.03	0.5	J	0.31	-0.01	U	0.02	-0.01	UJ	0.02	0.03	U	0.08	0.32	J	0.25	-0.01	U	-0.01	0.09	0.81	J	1.2	0.4
								-14.96	*U*	*17.1*	*-15.16*	*U*	*16.89*													
1BH025-GW-001-0	7/9/02	0.12	U	0.16	1.19		0.47	-0.01	U	0.02	0.09	U	0.13	-0.01	U	0.01	1.58		0.55	0.11	U	0.16	0.16	2.86		4.3	0.73
								-13.96	*U*	*19.13*	*-69310*	*U*	*6530*													
1BH026-GW-001-0	7/15/02	0.3	J	0.24	0.35	J	0.21	0.03	U	0.11	0.03	UJ	0.07	0.21	J	0.2	0.26	J	0.18	0.53	J	0.79	0.33	0.65	J	1.0	0.29
								-7.27	*U*	*18.3*	*-22.47*	*U*	*22.52*													
1BH034-GW-001-0	7/12/02	0.5	J	0.32	1.89		0.54	0.11	U	0.16	0	J	0	0.04	U	0.09	1.78		0.52	0.65	J	0.97	0.37	3.66		5.5	0.75
								-9.24	*U*	*21.6*	*-1.47*	*U*	*19.99*													
1BH035-GW-001-0	7/12/02	0.23	UJ	0.23	1.67		0.56	0.07	UJ	0.14	-0.01	U	0.01	0.04	U	0.12	1.8		0.59	0.34	J	0.51	0.3	3.47		5.2	0.81
								2.42	*U*	*20.11*	*-10.19*	*U*	*17.95*													

Notes:

TPU = Total Propagated Uncertainty

pCi/L = Picocuries per Liter

ug/L = Micrograms per Liter

(a) = Sample analyzed by both alpha and gamma spectroscopy - gamma results shown in *italics*

U = Result is less than the sample specific MDC

J = Result is an estimated value

pCi/L results are converted to ug/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 4-16
Radiochemical Analysis of Groundwater Geoprobe Samples. AOC 1

		GROSS ALPHA				GROSS BETA				RADIUM - TOTAL				Th-234			
MCL (pCi/L)		15				NA				5 (RA-226/228 combined)				N/A			
		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
1BH001-GW-001-0	7/12/02	-0.05 U	1.4	0.64 UJ	1.34	3.11 J	1.98	4.28	1.56	0.95 J	0.67	0.68 J	0.67	363	85.96	225.5	88.33
1BH002-GW-001-0	7/10/02	0.96 UJ	2.1	**141.04**	49.58	4.8 J	2.9	205.51	40.42	0.4 UJ	0.48	**9.15**	2.37	-176300 U	18830	18.42 UJ	67.68
1BH003-GW-001-0	7/10/02	1.28 J	0.84	0.24 UJ	0.91	5.26	1.87	6.57	1.71	0.78 J	0.55	1.91	0.81	-18.58 U	50.15	99.28 J	84.42
1BH004-GW-001-0	7/10/02	2.04 UJ	4.56	**96.67**	39.45	8.84 J	6.4	229.8	42.47	0.82 J	0.62	**13.92**	2.26	194.7	77.33	63.04 UJ	74.89
1BH006-GW-001-0	7/12/02	1 UJ	2.04	8.16	2.7	3.45 J	2.25	24.95	2.52	1.55 J	0.8	2.96	1.06	157.4	76.87	3.45 UJ	53.4
1BH007-GW-001-0	7/1/02	12.83 J	4.63	**56.74** J	8.7	2.27 UJ	4.19	47.06 J	5.59	0.37 UJ	0.39	1.22 J	0.59	59.84 J	54	14.53 U	48.56
1BH011-GW-001-0	7/10/02			8.97	3.08			19.7	4			1.74 K	0.82			-77.22 U	49.19
1BH012-GW-001-0	6/28/02	0.72 UJ	2.75	10.78	2.26	3.99 J	2.65	5.71 J	2.2	0.24 UJ	0.52	0.51 J	0.5	-71.06 U	47.93	28.69 UJ	49.21
1BH013-GW-001-0	6/28/02	-4.14 U	3.92	-2.13 U	3.34	10.58 J	3.31	9.22 J	3.91	0.47 UJ	0.57	0.35 UJ	0.44	-56.39 U	49.87	-96.97 U	55.48
1BH014-GW-001-0	6/28/02	-1.45 U	2.66	0.69 UJ	2.14	8.08 J	2.35	6.1 J	3.02	0.77 J	0.67	0.11 UJ	0.27	9.23 UJ	78.98	30.26 UJ	48.39
1BH016-GW-001-0	7/8/02	3.07 UJ	3.67	-2.91 U	4.72	6.47 J	5.89	8.03 J	4.8	0.55 J	0.52	1.14 J	0.66	-53.04 U	53.26	63.06 J	49.13
1BH017-GW-001-0	7/8/02	8.69	4.1	8.15	3.03	11.68	3.9	9.59	3.89	0.91 J	0.61	0.9 J	0.54	-48.47 U	53.96	88.19 J	50.6
1BH018-GW-001-0	7/1/02	9.83 J	2.49	7.67 J	1.83	4.16 J	3.68	8.47 J	1.46	0.96 J	0.53	0.31 J	0.31	57.82 J	48.4	-95.69 U	54.03
1BH019-GW-001-0	6/28/02	-0.78 U	3.29	-0.22 U	2.31	28.26 J	4.07	16 J	1.68	1.18 J	0.63	0.29 UJ	0.44	55.91 J	49.44	12.6 UJ	51.41
1BH020-GW-001-0	6/28/02	0.31 U	1.08	5.15	2.19	3.36 J	1.28	10.03 J	2.7	-0.16 UJ	0.25	0.2 UJ	0.38	-12.19 U	54.04	-38.21 U	49.49
1BH021-GW-001-0	6/28/02	5.04	1.06	-1.27 U	1.97	2.05 J	1.47	17.5 J	1.84	0.93 J	0.61	0.33 UJ	0.37	-2.22 U	48.97	345.4	81.38
1BH023-GW-001-0	7/9/02	1.93 UJ	2.3	**19.08**	8.27	6.31	2.85	35.55	8.22	0.24 U	0.51	2.56	1	24.33 UJ	67.81	29.26 UJ	47.61
1BH024-GW-001-0	7/9/02	0.52 U	2.85	4.61 J	3.92	2.58 U	3.13	10.8	3.89	0.45 J	0.4	0.63 J	0.59	55.23 U	67.23	62.22 UJ	69.1
1BH025-GW-001-0	7/9/02	0.6 U	3.66	4.5 J	3.95	2.68 U	4.5	5.58 J	3.99	1.37 J	0.71	0.62 J	0.58	106 J	84.65	-176300 UJ	18830
1BH026-GW-001-0	7/15/02	2.02 UJ	4.98	5.93 J	4.51	2.82 UJ	5.85	3.52 UJ	5.94	0.9 J	0.71	0.48 UJ	0.52	-24.13 U	45.84	105.4 J	58.56
1BH034-GW-001-0	7/12/02	0.93 UJ	6.64	4.12 UJ	4.66	61.69	8.77	18.33	6.83	0.68 J	0.55	2.3	0.96	172.4	80.25	-43.93 U	46.51
1BH035-GW-001-0	7/12/02	-2.76 U	3.81	2.96 UJ	4.17	4.67 J	2.54	8.29	3.73	0.95 J	0.66	0.48 UJ	0.64	39.47 UJ	73.25	23.52 UJ	74.59

Notes:

MCL = Maximum Contaminant Level

NA = Not Applicable

pCi/L = Picocuries per liter

TPU = Total Propagated Uncertainty

J = Result is an estimated value

U = Result is less than the sample specific MDC

Shading indicate detected concentrations which equal or exceed the MCLs

Table 4-17
Isotopic and Total Uranium in Groundwater Geoprobe Samples, AOC 2

		U-234				U-235 [a]				U-238				Uranium (Total)							
		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered				Unfiltered			
Sample ID	Sample Date	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]
2BH001-GW-001-0	7/22/02	0.09	U	0.17	1.52		0.52	0.06	U	0.15	0.37		0.26	0.04	U	0.12	0.99		0.4	0.19	U	0.28	0.26	2.88		4.3	0.71
								-9.75	*U*	*17.23*	*-17.26*	*U*	*22.04*														
2BH003-GW-001-0	7/22/02	0.23	J	0.22	3.73		0.96	-0.01	U	0.02	0.08	U	0.12	0.05	UJ	0.1	3.02		0.82	0.26	J	0.39	0.24	6.82		10.2	1.27
								6.03	*U*	*17.55*	*9.06*	*UJ*	*28.36*														
2BH004-GW-001-0	7/29/02	0.22	J	0.18	0.78		0.35	0.04	UJ	0.08	-0.01	U	0.01	0.29		0.2	0.85		0.37	0.56	J	0.84	0.28	1.62		2.4	0.51
								-16.84	*U*	*17.26*	*14.87*	*UJ*	*19.78*														
2BH005-GW-001-0	7/23/02	0.15	UJ	0.16	1.84		0.59	0	J	0	0.13	UJ	0.15	0.23	J	0.19	1.01		0.41	0.38	J	0.57	0.25	2.98		4.5	0.74
								-12.28	*U*	*17.02*	*-17.85*	*U*	*19.73*														
2BH006-GW-001-0	7/23/02	0.14	UJ	0.21	2.52		0.69	-0.02	U	0.03	0	J	0	0	J	0	1.96		0.58	0.13	U	0.19	0.21	4.47		6.7	0.9
								1.25	*U*	*17.15*	*20.73*	*J*	*19.06*														
2BH007-GW-001-0	7/23/02	0.1	UJ	0.14	0.74		0.39	-0.01	U	0.02	0.06	UJ	0.11	-0.01	U	0.02	0.14	UJ	0.16	0.08	U	0.12	0.15	0.93		1.4	0.44
								0.8	*U*	*19.27*	*-1.24*	*U*	*22.44*														
2BH008-GW-001-0	7/25/02	2.02	J	1.58	9.62		2.38	0.65	UJ	0.93	0.58	J	0.42	2.1	J	1.57	8.07		2.07	4.76	J	7.14	2.42	18.27		27.4	3.19
								-12.38	*U*	*16.97*	*-11.67*	*U*	*22.56*														
2BH010-GW-001-0	7/30/02	0.5	J	0.43	13.43		2.65	-0.02	U	0.04	0.69		0.37	0.52	J	0.43	13.16		2.61	1	J	1.50	0.61	27.28		**40.9**	3.74
								-12.34	*U*	*22.03*	*-10.09*	*U*	*19.93*														
2BH011-GW-001-0	7/15/02	0.19	UJ	0.22	0.35		0.22	0.26	UJ	0.27	0	J	0	0.2	UJ	0.21	0.38	J	0.23	0.66	J	0.99	0.4	0.73		1.1	0.32
								16.05	*UJ*	*24.56*	*7.76*	*UJ*	*25.24*														
2BH012-GW-001-0	8/13/02	1.85		0.54	2.69		0.72	0.2	J	0.17	0.11	UJ	0.13	0.91		0.35	0.75		0.32	2.96		4.44	0.67	3.55		5.3	0.8
								1.3	*U*	*19.47*	*-4.7*	*U*	*17.07*														
2BH013-GW-001-0	8/8/02	5.58		1.97	5.73		1.46	0.17	UJ	0.34	0.05	U	0.12	7.33		2.33	6.02		1.52	13.08		19.61	3.07	11.8		17.7	2.11
								-18.7	*U*	*19.62*	*-1.07*	*U*	*18.19*														
2BH014-GW-001-0	7/25/02	0.2	UJ	0.26	8.4		2.35	0	J	0	0.27	UJ	0.32	0.3	UJ	0.3	7.48		2.14	0.49	J	0.73	0.4	16.16		24.2	3.19
								-13.06	*U*	*19.57*	*-4.24*	*U*	*19.61*														
2BH016-GW-001-0	7/22/02	0.48	UJ	0.64	3.34		0.83	-0.04	U	0.08	0.22	J	0.18	0.54	UJ	0.64	2.81		0.74	0.98	J	1.47	0.91	6.37		9.6	1.12
								-18.21	*U*	*17.4*	*8.72*	*U*	*19.83*														
2BH017-GW-001-0	8/5/02	0.36	UJ	0.43	0.5		0.28	-0.03	U	0.05	-0.01	U	0.02	0.08	UJ	0.25	0.52		0.29	0.42	UJ	0.63	0.5	1.01		1.5	0.4
								16.05	*UJ*	*19.48*	*5.03*	*U*	*15.8*														
2BH018-GW-001-0	8/1/02	417.7		81.37	1143		243.6	22.83		12.73	53.03		28.94	465.6		89.02	1142		243.2	906.13		**1358.52**	121.28	2338.03		**3505.3**	345.43
								10.56	*UJ*	*25.18*	*57.1*	*J*	*28.64*														
2BH019-GW-001-0	8/21/02	4.85		1.49	6.08		1.42	0.16	UJ	0.23	0.28	J	0.23	5.51		1.63	4.91		1.21	10.52		15.77	2.22	11.27		16.9	1.88
								23.44	*UJ*	*31.4*	*6.73*	*U*	*16.86*														
2BH020-GW-001-0	7/15/02	0.43	J	0.4	0.47		0.25	0.11	UJ	0.21	0.04	UJ	0.08	0.16	UJ	0.25	0.28		0.19	0.69	J	1.03	0.51	0.78		1.2	0.33
								-23.9	*U*	*22.88*	*-9.01*	*U*	*19.8*														
2BH021-GW-001-0	8/8/02	0.17	J	0.14	0.44		0.25	0.03	UJ	0.07	0.04	UJ	0.07	0.11	UJ	0.11	0.33		0.21	0.32	J	0.48	0.19	0.81		1.2	0.33
								0.12	*U*	*17.45*	*2.95*	*U*	*19.97*														
2BH022-GW-001-0	8/7/02	0.23	J	0.18	4.34		0.95	0	J	0	0.37		0.22	0.23	J	0.18	3.31		0.78	0.46	J	0.69	0.26	8.02		12.0	1.25
								1.04	*U*	*21.99*	*-2.34*	*U*	*15.65*														
2BH025-GW-001-0	8/5/02	0.82	J	0.57	2.47		0.74	0.1	UJ	0.21	0.14	UJ	0.16	0.42	J	0.39	3.39		0.92	1.35	J	2.02	0.72	5.99		9.0	1.19
								7.43	*U*	*17.14*	*-31.98*	*U*	*19.08*														

Table 4-17
Isotopic and Total Uranium in Groundwater Geoprobe Samples, AOC 2
(cont.)

		U-234				U-235 [(a)]				U-238				Uranium (Total)							
		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered				Unfiltered			
Sample ID	Sample Date	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]	Result (pCi/L)	Flag	Result (ug/L)	TPU [+/- 2σ]
2BH026-GW-001-0	8/19/02	1.31		0.67	2.92		0.8	-0.01	U	0.03	0.13	UJ	0.15	0.79	J	0.5	2.44	0.71	2.08		3.12	0.83	5.49		8.2	1.08
								25.75	*J*	*24.53*	*-3.14*	*U*	*18.98*													
2BH028-GW-001-0	8/6/02	-0.02	U	0.09	0.75	K	0.29	0.05	U	0.09	0.11	UJ	0.11	0.1	UJ	0.11	0.91 K	0.32	0.13	U	0.19	0.17	1.77	K	2.7	0.44
								3.79	*U*	*22.8*	*-12.33*	*U*	*17.17*													
2BH029-GW-001-0	8/6/02	0.22	J	0.2	0.93		0.34	0.08	UJ	0.12	0.03	UJ	0.06	0.21	J	0.18	0.74	0.3	0.52	J	0.78	0.29	1.7		2.5	0.46
								-3.7	*U*	*19.81*	*-7.81*	*U*	*18.4*													
2BH030-GW-001-0	8/2/02	0.6	J	0.41	2.09		0.63	0.06	U	0.15	0.12	UJ	0.14	0.17	UJ	0.22	1.93	0.59	0.84	J	1.26	0.49	4.14		6.2	0.87
								-21.61	*U*	*18.71*	*10.41*	*U*	*20*													
2BH031-GW-001-0	8/14/02	5.34		1.53	7.8		1.76	0.27	UJ	0.3	0.3	J	0.25	3.96		1.24	5.68	1.37	9.57		14.35	1.99	13.77		20.6	2.24
								-8.07	*U*	*19.52*	*2.15*	*U*	*23.39*													
2BH033-GW-001-0	8/19/02	-0.76	U	0.4	1.46	L	0.46	-0.13	U	0.15	0.1	UJ	0.11	0.23	U	0.6	1.11 L	0.38	-0.65	U	-0.97	0.73	2.66		4.0	0.61
								2.72	*U*	*18.78*	*-20.63*	*U*	*19.68*													
2BH034-GW-001-0	8/2/02	0.23	J	0.19	0.24	J	0.19	0.04	UJ	0.08	0	J	0	0.07	UJ	0.1	0.2 J	0.18	0.34	J	0.51	0.23	0.44	J	0.7	0.26
								-1.13	*U*	*17*	*3.92*	*U*	*17.06*													
2BH035-GW-001-0	8/6/02	0.13	U	0.22	0.94		0.33	0.14	U	0.22	0	J	0	0.1	U	0.18	1.01	0.35	0.38	J	0.57	0.36	1.95		2.9	0.48
								14.38	*UJ*	*17.72*	*-9.23*	*U*	*19.47*													
2BH036-GW-001-0	8/2/02	0.09	UJ	0.11	4.01		0.93	-0.01	U	0.01	0.1	UJ	0.12	0.26	J	0.19	3.81	0.89	0.35	J	0.52	0.22	7.93		11.9	1.29
								-31.45	*U*	*19.21*	*-2.07*	*U*	*19.72*													
2BH037-GW-001-0	8/6/02	0.29	J	0.19	4.89		1.06	0	J	0	0.15	UJ	0.15	0.26	J	0.17	5.34	1.13	0.55	J	0.82	0.25	10.37		15.5	1.56
								-10.25	*U*	*17.29*	*15.6*	*UJ*	*22.76*													
2BH039-GW-001-0	8/7/02	0.44		0.24	0.76		0.31	0.11	UJ	0.13	0.06	U	0.1	0.55		0.27	0.56	0.26	1.09		1.63	0.38	1.38		2.1	0.42
								20.33	*UJ*	*21.94*	*-11.84*	*U*	*18.27*													
2BH040-GW-001-0	8/7/02	0.2	J	0.15	1.39		0.42	0.07	UJ	0.09	0.03	UJ	0.06	0.29		0.18	1.46	0.43	0.56	J	0.84	0.26	2.87		4.3	0.61
								3.14	*U*	*18.43*	*3.57*	*U*	*18*													
2BH041-GW-001-0	8/7/02	0.32		0.2	4.17		0.99	0.03	U	0.07	0.29	J	0.22	0.37	J	0.22	4.37	1.02	0.72		1.08	0.3	8.83		13.2	1.43
								16.73	*UJ*	*17.96*	*1.19*	*U*	*20.13*													
2BH042-GW-001-0	7/19/02	2.725		0.8342	19.15		3.478	0.1051	UJ	0.1497	0.9185		0.3994	3.223		0.9329	19.8	3.583	6.05		9.07	1.26	39.87		**59.8**	5.01
								-1.173	*U*	*17.83*	*-4.85*	*U*	*16.42*													

Notes:

pCi/L = Picocuries per Liter

TPU = Total Propagated Uncertainty

U = Result is less than the sample specific MDC

J = Result is an estimated value

(a) = Sample analyzed by both alpha and gamma spectroscopy - gamma results shown in *italics*

ug/L = Micrograms per Liter

Shading indicates results above MCL of 30 ug/L total uranium

pCi/L results are converted to ug/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 4-18
Radiochemical Analysis of Groundwater Geoprobe Samples, AOC 2

		GROSS ALPHA				GROSS BETA				RADIUM - TOTAL				Th-234			
MCL (pCi/L)		15				NA				5 (RA-226/288 combined)				N/A			
		Filtered				Filtered				Filtered				Filtered			
		Result		TPU		Result		TPU		Result		TPU		Result		TPU	
Sample ID	Sample Date	(pCi/L)	Flag	[+/- 2σ]		(pCi/L)	Flag	[+/- 2σ]		(pCi/L)	Flag	[+/- 2σ]		(pCi/L)	Flag	[+/- 2σ]	
2BH001-GW-001-0	7/22/02	-2.63	U	7.1		18.62		`		0.09	U	0.46		9.68	U	49.24	
2BH003-GW-001-0	7/22/02	-2.42	U	7.06		44.86		6.84		0.54	UJ	0.57		29.41	UJ	68.73	
2BH004-GW-001-0	7/29/02	-0.83	U	3.94		6.07	UJ	6.15		1.99		0.82		7.51	UJ	45.52	
2BH005-GW-001-0	7/23/02	0	U	2.43		23.06		2.6		1.05	J	0.6		50.1	UJ	68.75	
2BH006-GW-001-0	7/23/02	-3.91	U	5.57		9.35	J	5.45		1.57	K	0.72		16	UJ	67.59	
2BH007-GW-001-0	7/23/02	-0.14	U	3.41		24.19		4.47		1.38		0.69		53.06	UJ	72.6	
2BH008-GW-001-0	7/25/02	10.8	J	6.7		28.02		9.97		1.09	B	0.4		41.28	UJ	72.88	
2BH010-GW-001-0	7/30/02	0.98	UJ	5.21		18.1		5.89		4.54		1.73		208.6		81.02	
2BH011-GW-001-0	7/15/02	2.75	UJ	3.28		9.35		3.8		0.65	J	0.53		171.3		74.68	
2BH012-GW-001-0	8/13/02	-1.03	UJ	5.47		1.98	UJ	5.01		1	J	0.6		33.31	UJ	50.39	
2BH013-GW-001-0	8/8/02	**231**		44.08		228.68		45.46		**13.32**		5.32		53.35	UJ	88.98	
2BH014-GW-001-0	7/25/02	0.9	UJ	1.48		27.44		1.99		0.97	B	0.38		-26.83	U	40.89	
2BH016-GW-001-0	7/22/02	3.69	UJ	6.61		14.46	J	9.95		1.1	J	0.61		56.59	J	49.86	
2BH017-GW-001-0	8/5/02	3.88	UJ	4.72		21.92		7.84		1.24		0.56		28.15	UJ	49.63	
2BH018-GW-001-0	8/1/02	**864**		30.7		770		21.06		**6.31**		1.17		443.6		78.21	
2BH019-GW-001-0	8/21/02	9.98		2.89		25.08		3.21		1.4		0.59		-58.37	U	50.39	
2BH020-GW-001-0	7/15/02	0.55	UJ	2.03		5.17		2.4		1.03	J	0.68		125.7	J	59.7	
2BH021-GW-001-0	8/802	4.8	J	3.43		2.32	UJ	6.43		0.66	J	0.46		41.74	UJ	67.66	
2BH022-GW-001-0	8/7/02	4.21	J	2.7		29.62		4.28		1.24		0.56		287.1		77.79	
2BH025-GW-001-0	8/5/02	-2.93	U	4.81		22.99		4.5		0.55	B	0.41		-34.19	U	47.91	
2BH026-GW-001-0	8/19/02	0.84	UJ	4.82		7.85		3.58		2.74		0.84		-79.02	U	52.05	
2BH028-GW-001-0	8/6/02	**17.61**		4.85		5.95	J	5.49		1.97		0.8		71.55	J	55.2	
2BH029-GW-001-0	8/6/02	0.29	UJ	3.82		39.93		4.54		1.04		0.57		-22.04	UJ	42.83	
2BH030-GW-001-0	8/2/02	4.13		2.07		22.78		4.72		0.94	B	0.49		18.71	UJ	49.58	
2BH031-GW-001-0	8/14/02	-0.56	UJ	14.66		5.51	UJ	11.48		2.88		1.23		22.89	UJ	48.88	
2BH033-GW-001-0	8/19/02	6.31	J	5.09		0.38	UJ	7.31		1.04		0.52		54.52	UJ	55.69	
2BH034-GW-001-0	8/2/02	6.13	J	3.89		-5.03	UJ	6.68		0.65	B	0.41		52.53	J	50.13	
2BH035-GW-001-0	8/6/02	-0.76	UJ	3.8		18.85		4.16		1.56		0.73		-78.31	UJ	49.79	
2BH036-GW-001-0	8/2/02	-3.34	U	3.01		-1.51	UJ	4.07		0.92	B	0.49		146.3		76.76	
2BH037-GW-001-0	8/6/02	-1.51	UJ	2.73		4.16	J	2.85		1.32	J	0.73		42.43	UJ	66.82	
2BH039-GW-001-0	8/7/02	3.06		1.33		2.7	J	1.48		0.65	J	0.39		-99.04	U	46.02	
2BH040-GW-001-0	8/7/02	1.17	UJ	1.67		1.1	UJ	3.75		0.8	J	0.45		41.4	UJ	51.39	
2BH041-GW-001-0	8/7/02	2.32	J	1.45		6.95		1.65		2.02		0.92		-16.83	U	44.75	
2BH042-GW-001-0	7/19/02	5.74		2.096		4.79		1.305		0.70	J	0.601		3.38	U	48.62	

Sample ID	Sample Date	Result (pCi/L)	Flag	TPU [+/- 2σ]		Result (pCi/L)	Flag	TPU [+/- 2σ]		Result (pCi/L)	Flag	TPU [+/- 2σ]		Result (pCi/L)	Flag	TPU [+/- 2σ]	
2BH001-GW-001-0	7/22/02	**11.28**	J	6.43		19.34		7.02		1.91		0.84		30.9	UJ	71.64	
2BH003-GW-001-0	7/22/02	**59.5**		29.96		133.19		36.18		**7.27**		1.7		150.5		62.12	
2BH004-GW-001-0	7/29/02	-1.04	U	6.98		5.65	UJ	7.78		1.67	J	0.81		84.26	J	77.27	
2BH005-GW-001-0	7/23/02	11.09		4.2		34.25		3.81		1.86	J	0.96		16.65	U	46.34	
2BH006-GW-001-0	7/23/02	**66.33**		12.12		51.1		8.46		**9.2**		1.75		233.8		84.04	
2BH007-GW-001-0	7/23/02	0.94	UJ	3.3		23.85		3.8		0.82	J	0.64		92.52	J	58.74	
2BH008-GW-001-0	7/25/02	**99.7**		20.71		174.7		21.01		**11.12**	B	1.41		31.93	UJ	56.38	
2BH010-GW-001-0	7/30/02	**253**		56.29		397.74		70.75		**23.94**		2.78		13.98	UJ	68.41	
2BH011-GW-001-0	7/15/02	3.49	J	2.93		10.2		4.47		1.24	J	0.75		22.08	UJ	67.37	
2BH012-GW-001-0	8/13/02	7.7		3.5		14.55		4.18		0.76	J	0.5		-33.48	U	48.13	
2BH013-GW-001-0	8/8/02	**663**		123.75		788.27		96.54		**24.41**		2.97		29.32	UJ	70.36	
2BH014-GW-001-0	7/25/02	**276**		40.54		328.64		41.47		**12.49**	B	1.43		-60.59	U	43.74	
2BH016-GW-001-0	7/22/02	**74.9**		17.07		90.29		15.84		**6.66**		1.52		8.14	U	47.04	
2BH017-GW-001-0	8/5/02	8.5	J	6.25		18.66		9.02		0.9	B	0.52		21.64	U	45.13	
2BH018-GW-001-0	8/1/02	**2004**		46.69		2087.74		29.42		**6.37**		1.15		1006		144.8	
2BH019-GW-001-0	8/21/02	**18.3**		5.59		42.63		5.03		2.03		0.79		0.74	U	48.88	
2BH020-GW-001-0	7/15/02	5.67		2.63		9.98		2.63		2.59		0.95		17.55	U	44.89	
2BH021-GW-001-0	8/802	5.88	J	3.09		8.63		3.62		1.11	J	0.55		253.4		73.74	
2BH022-GW-001-0	8/7/02	**164.73**		37.04		267.08		45.64		4.54		1.07		12.86	U	51.78	
2BH025-GW-001-0	8/5/02	**24.18**		6.35		38.29		9.59		1.64		0.61		37.7	UJ	48.4	
2BH026-GW-001-0	8/19/02	**36.77**		5.96		24.59		6.16		**5.9**		1.46		21.56	UJ	47.58	
2BH028-GW-001-0	8/6/02	**59.45**		11.28		41.87		8.09		1.8		0.83		-27.28	UJ	51.05	
2BH029-GW-001-0	8/6/02	10.41	J	9.2		74.26		8.98		2.23		0.82		8.25	UJ	53.39	
2BH030-GW-001-0	8/2/02	**32.8**		6.94		65.3		7.48		2.98		0.97		7.65	U	45.03	
2BH031-GW-001-0	8/14/02	**32.47**	J	19.37		52.6		15.68		3.55		1.03		-53.22	U	56.13	
2BH033-GW-001-0	8/19/02	7.53	UJ	10.68		7.53	UJ	8.83		2.95		1		14.75	UJ	44.56	
2BH034-GW-001-0	8/2/02	8.01	J	5.45		3.05	UJ	6.35		0.74	B	0.43		74.03	J	70.85	
2BH035-GW-001-0	8/6/02	**16.24**		7.88		41.37		8.13		2.31		0.83		2.3	UJ	42.3	
2BH036-GW-001-0	8/2/02	**36.68**		7.62		40.45		10.04		4.3		1.3		-49.99	U	43.18	
2BH037-GW-001-0	8/6/02	**19.78**	J	10.48		41.05		11.26		4.09		1.17		4.38	UJ	49.46	
2BH039-GW-001-0	8/7/02	5.31		1.7		3.03	J	2.09		0.5	J	0.35		10.61	U	44.22	
2BH040-GW-001-0	8/7/02	**129**		16.01		78.01		11.89		2.95		0.81		-58.25	U	50.71	
2BH041-GW-001-0	8/7/02	**82**		13.7		96.54		15.28		**8.86**		2.27		-38.15	U	43.89	
2BH042-GW-001-0	7/19/02	**38.1**		3.995		41.5		2.872		2.11		0.850		2.827	U	50.38	

Notes:

MCL = Maximum Contaminant Level
N/A = Not Applicable
pCi/L = Picocuries per liter
TPU = Total Propagated Uncertainty
B = Analyte is detected in blank as well as sample
J = Result is an estimated value
U = Result is less than the sample specific MDC
Shading indicates detected concentrations which equal or exceed the MCLs

Table 4-19
Water Level Data, Operable Units 1 and 2

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
A Aquifer Wells							
Q1	8/3/05	2-MW-02A	8.30	9.00	2	5.40	2.90
Q2	10/13/05		8.30	9.00	2	4.81	3.49
Q3	1/23/06		8.30	9.00	2	5.31	2.99
Q4	5/4/06		8.30	9.00	2	5.14	3.16
Q5	9/11/06		8.30	9.00	2	5.37	2.93
Q6	2/13/07		8.30	9.00	2	6.15	2.15
					AVERAGE	**5.36**	**2.94**
Q1	8/2/05	1-MW-06A	7.20	9.87	2	5.75	1.45
Q2	10/6/05		7.20	9.87	2	4.67	2.53
Q3	1/19/06		7.20	9.87	2	5.45	1.75
Q4	4/27/06		7.20	9.87	2	4.99	2.21
Q5	9/7/06		7.20	9.87	2	5.35	1.85
Q6	2/7/07		7.20	9.87	2	6.06	1.14
					AVERAGE	**5.38**	**1.82**
Q1	8/10/05	1-MW-08A	8.52	9.61	2	6.31	2.21
Q2	10/10/05		8.52	9.61	2	4.92	3.60
Q3	1/18/06		8.52	9.61	2	5.45	3.07
Q4	4/28/06		8.52	9.61	2	4.99	3.53
Q5	9/11/07		8.52	9.61	2	5.41	3.11
Q6	2/9/07		8.52	9.61	2	6.15	2.37
					AVERAGE	**5.54**	**2.98**
Q1	8/26/05	1-MW-10A	8.96	9.60	10	6.33	2.63
Q2	10/10/05		8.96	9.60	10	3.90	5.06
Q3	1/17/06		8.96	9.60	10	4.85	4.11
Q4	4/28/06		8.96	9.60	10	4.51	4.45
Q5	9/7/06		8.96	9.60	10	5.00	3.96
Q6	2/8/07		8.96	9.60	10	6.50	2.46
					AVERAGE	**5.18**	**3.78**
Q1	8/3/05	2-MW-12A	7.91	10.04	2	4.94	2.98
Q2	10/11/05		7.91	10.04	2	4.50	3.41
Q3	1/23/06		7.91	10.04	2	4.88	3.03
Q4	5/3/06		7.91	10.04	2	4.73	3.18
Q5	9/8/06		7.91	10.04	2	4.99	2.92
Q6	2/8/07		7.91	10.04	2	5.68	2.23
					AVERAGE	**4.95**	**2.96**
Q1	8/26/05	2-MW-15A	7.73	9.10	2	6.15	1.58
Q2	10/13/05		7.73	9.10	2	5.90	1.83
Q3	1/25/06		7.73	9.10	2	5.87	1.86
Q4	5/5/06		7.73	9.10	2	5.61	2.12
Q5	9/12/07		7.73	9.10	2	5.82	1.91
Q6	2/15/07		7.73	9.10	2	6.47	1.26
					AVERAGE	**5.97**	**1.76**
Q1	8/10/05	1-MW-18A	7.69	9.62	2	5.54	2.15
is consistent w	10/6/05		7.69	9.62	2	4.42	3.27
Q3	1/18/06		7.69	9.62	2	5.15	2.54

Table 4-19
Water Level Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
Q4	5/1/06	1-MW-18A	7.69	9.62	2	4.56	3.13
Q5	9/7/06		7.69	9.62	2	5.06	2.63
Q6	2/7/07		7.69	9.62	2	5.92	1.77
					AVERAGE	**5.11**	**2.58**
Q1	8/25/05	2-MW-19A	3.23	6.36	2	6.21	-2.98
Q2	10/14/05		3.23	6.36	2	6.01	-2.78
Q3	1/23/06		3.23	6.36	2	2.55	0.68
Q4	5/4/06		3.23	6.36	2	2.38	0.85
Q5	9/13/06		3.23	6.36	2	2.65	0.58
Q6	2/14/07		3.23	6.36	2	2.49	0.74
					AVERAGE	**3.72**	**-0.49**
Q1	8/8/05	2-MW-20A	6.05	9.96	2	4.74	1.31
Q2	10/13/05		6.05	9.96	2	5.90	0.15
Q3	1/20/06		6.05	9.96	2	4.81	1.24
Q4	5/3/06		6.05	9.96	2	4.45	1.60
Q5	9/12/06		6.05	9.96	2	4.65	1.40
Q6	2/9/07		6.05	9.96	2	5.38	0.67
					AVERAGE	**4.99**	**1.06**
Q1	8/10/05	1-MW-21A	7.52	11.61	2	5.42	2.10
Q2	10/7/05		7.52	11.61	2	4.40	3.12
Q3	1/19/06		7.52	11.61	2	5.22	2.30
Q4	5/1/06		7.52	11.61	2	4.83	2.69
Q5	9/7/06		7.52	11.61	2	4.99	2.53
Q6	2/7/07		7.52	11.61	2	7.77	-0.25
					AVERAGE	**5.44**	**2.08**
Q1	8/11/05	1-MW-22A	8.07	9.13	2	4.52	3.55
Q2	10/7/05		8.07	9.13	2	3.51	4.56
Q3	1/19/06		8.07	9.13	2	4.02	4.05
Q4	4/28/06		8.07	9.13	2	3.54	4.53
Q5	9/8/06		8.07	9.13	2	3.99	4.08
Q6	2/7/07		8.07	9.13	2	4.41	3.66
					AVERAGE	**4.00**	**4.07**
Q1	8/10/05	2-MW-24A	7.70	10.55	2	4.38	3.32
Q2	10/10/05		7.70	10.55	2	3.10	4.60
Q3	1/20/06		7.70	10.55	2	3.86	3.84
Q4	5/1/06		7.70	10.55	2	3.28	4.42
Q5	9/8/06		7.70	10.55	2	3.91	3.79
Q6	2/7/07		7.70	10.55	2	4.25	3.45
					AVERAGE	**3.80**	**3.90**
Q1	8/9/05	2-MW-26A	8.09	10.22	2	6.68	1.41
Q2	10/11/05		8.09	10.22	2	5.60	2.49
Q3	1/24/06		8.09	10.22	2	6.61	1.48
Q4	5/1/06		8.09	10.22	2	6.13	1.96
Q5	9/11/06		8.09	10.22	2	6.23	1.86
Q6	2/8/07		8.09	10.22	2	7.20	0.89
					AVERAGE	**6.41**	**1.68**
					A AQUIFER AVERAGE	**5.06**	**2.39**

Table 4-19
Water Level Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
B Aquifer Wells							
Q1	8/26/05	2-MW-01B	7.45	22.70	10	7.05	0.40
Q2	10/4/05		7.45	22.70	10	8.44	-0.99
Q3	1/26/06		7.45	22.70	10	10.53	-3.08
Q4	5/4/06		7.45	22.70	10	*10.62*	*-3.17*
Q5	9/14/06		7.45	22.70	10		
Q6	2/14/07		7.45	22.70	10	*9.35*	-1.90
					AVERAGE	***9.20***	***-1.75***
Q1	7/18/05	2-MW-03B	7.45	17.43	10	6.25	1.20
Q2	10/4/05		7.45	17.43	10	5.26	2.19
Q3	1/24/06		7.45	17.43	10	6.25	1.20
Q4	5/4/06		7.45	17.43	10	5.75	1.70
Q5	9/12/06		7.45	17.43	10	5.95	1.50
Q6	2/14/07		7.45	17.43	10	6.92	0.53
					AVERAGE	**6.06**	**1.39**
Q1	7/26/05	2-MW-04B	8.02	22.50	10	6.72	1.30
Q2	10/5/05		8.02	22.50	10	5.85	2.17
Q3	1/23/06		8.02	22.50	10	6.70	1.32
Q4	5/3/06		8.02	22.50	10	6.23	1.79
Q5	9/12/06		8.02	22.50	10	6.42	1.60
Q6	2/8/07		8.02	22.50	10	7.40	0.62
					AVERAGE	**6.55**	**1.47**
Q1	8/26/05	2-MW-05B	7.57	23.10	10	6.32	1.25
Q2	10/5/05		7.57	23.10	10	5.33	2.24
Q3	1/25/06		7.57	23.10	10	6.31	1.26
Q4	5/4/06		7.57	23.10	10	5.75	1.82
Q5	9/12/06		7.57	23.10	10	6.00	1.57
Q6	2/14/07		7.57	23.10	10	6.94	0.63
					AVERAGE	**6.11**	**1.46**
Q1	8/26/05	1-MW-07B	7.19	22.52	10	5.57	1.62
Q2	10/6/05		7.19	22.52	10	5.06	2.13
Q3	1/18/06		7.19	22.52	10	5.94	1.25
Q4	4/28/06		7.19	22.52	10	5.52	1.67
Q5	9/7/06		7.19	22.52	10	5.66	1.53
Q6	2/6/07		7.19	22.52	10	6.46	0.73
					AVERAGE	**5.70**	**1.49**
Q1	8/3/05	1-MW-09B	7.75	22.75	10	7.08	0.68
Q2	10/5/05		7.75	22.75	10	6.16	1.59
Q3	1/17/06		7.75	22.75	10	6.81	0.94
Q4	4/27/06		7.75	22.75	10	6.57	1.18
Q5	9/7/06		7.75	22.75	10	6.75	1.00
Q6	2/6/07		7.75	22.75	10	7.19	0.56
					AVERAGE	**6.76**	**0.99**
Q1	8/9/05	1-MW-11B	8.73	23.02	10	7.65	1.08
Q2	10/6/05		8.73	23.02	10	6.66	2.07
Q3	1/17/06		8.73	23.02	10	7.52	1.21
Q4	4/27/06		8.73	23.02	10	7.16	1.57

Table 4-19
Water Level Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
Q5	9/7/06	1-MW-11B	8.73	23.02	10	7.25	1.48
Q6	2/7/07		8.73	23.02	10	7.98	0.75
					AVERAGE	**7.37**	**1.36**
Q1	8/12/05	3-MW-13B	8.07	22.10	10	7.37	0.70
Q2	10/13/05		8.07	22.10	10	6.55	1.52
Q3	1/24/06		8.07	22.10	10	7.46	0.61
Q4	5/2/06		8.07	22.10	10	7.12	0.95
Q5	9/12/06		8.07	22.10	10	7.08	0.99
Q6	2/9/07		8.07	22.10	10	7.96	0.11
					AVERAGE	**7.26**	**0.81**
Q1	8/12/05	3-MW-14B	8.16	22.48	10	7.55	0.61
Q2	10/13/05		8.16	22.48	10	6.77	1.39
Q3	1/25/06		8.16	22.48	10	7.61	0.55
Q4	5/2/06		8.16	22.48	10	7.31	0.85
Q5	9/13/06		8.16	22.48	10	7.25	0.91
Q6	2/9/07		8.16	22.48	10	7.91	0.25
					AVERAGE	**7.40**	**0.76**
Q1	8/11/05	2-MW-16B	6.32	20.99	10	5.20	1.12
Q2	10/10/05		6.32	20.99	10	4.08	2.24
Q3	1/20/06		6.32	20.99	10	4.88	1.44
Q4	5/1/06		6.32	20.99	10	4.45	1.87
Q5	9/8/06		6.32	20.99	10	4.67	1.65
Q6	2/8/07		6.32	20.99	10	5.69	0.63
					AVERAGE	**4.83**	**1.49**
Q1	8/10/05	1-MW-17B	7.43	21.67	10	6.20	1.23
Q2	10/7/05		7.43	21.67	10	5.21	2.22
Q3	1/18/06		7.43	21.67	10	5.99	1.44
Q4	5/1/06		7.43	21.67	10	5.58	1.85
Q5	9/8/06		7.43	21.67	10	5.82	1.61
Q6	2/7/07		7.43	21.67	10	6.63	0.80
					AVERAGE	**5.91**	**1.53**
Q1	8/9/05	2-MW-23B	5.94	20.34	10	4.88	1.06
Q2	10/14/05		5.94	20.34	10	3.90	2.04
Q3	1/20/06		5.94	20.34	10	5.00	0.94
Q4	5/3/06		5.94	20.34	10	4.36	1.58
Q5	9/11/06		5.94	20.34	10	4.60	1.34
Q6	2/12/07		5.94	20.34	10	8.53	-2.59
					AVERAGE	**5.21**	**0.73**
					B AQUIFER AVERAGE	**6.49**	**1.02**

C Aquifer Wells							
Q1		2-MW-25C	7.00	36.75	10		
Q2	11/17/05		7.00	36.75	10		
Q3	1/24/06		7.00	36.75	10	11.15	-4.15
Q4	5/3/06		7.00	36.75	10	10.88	-3.88
Q5	9/11/06		7.00	36.75	10	10.59	-3.59
Q6	2/8/07		7.00	36.75	10	11.20	-4.20
					AVERAGE	**10.96**	**-3.96**

Table 4-19
Water Level Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
Q1	8/26/05	2-Stilling[(a)]	3.12			2.52	0.60
Q2	10/14/05		3.12			2.49	0.63
Q3	1/27/06		3.12			2.62	0.50
Q4			3.12			2.56	0.56
Q5			3.12			2.56	0.56
Q6	2/5/07		3.12			2.55	0.57
					AVERAGE	**2.55**	**0.57**

Notes:

ft = Feet
Elev = Elevation
GW = Groundwater
NAVD 88 = North American Vertical Datum 1988
(a) 2-Stilling is vertical pipe in ditch used for water elevation readings only

Table 4-20
Hydraulic Conductivities, Operable Units 1 and 2

Aquifer A		[cm/s]	[ft/day]
A	MW-02	7.00E-04	2
A	MW-06	1.00E-04	0.3
A	MW-10	2.00E-03	5
A	MW-12	8.00E-04	2
A	MW-15	3.00E-05	0.01
A	MW-18	2.00E-03	4
	A Aquifer Average	**9.00E-04**	**2.2**

Aquifer B		[cm/s]	[ft/day]
B	MW-04	5.00E-04	1.4
B	MW-07	5.00E-04	1.4
B	MW-09	1.00E-04	0.3
B	MW-13	2.00E-04	0.7
B	MW-14	8.00E-04	2
B	MW-16	3.00E-04	0.9
B	MW-17	8.00E-04	2
	B Aquifer Average	**5.00E-04**	**1.1**

Notes:

cm/s = Centimeters per second

ft/day = Feet per day

Table 4-21
YSI Water Quality Data, Operable Units 1 and 2

Quarter	Date	Well ID	Temp. °C	pH	Cond. (mS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
A Aquifer Wells								
Q1	8/3/05	2-MW-02A	29.38	6.48	1106.00	1.80	0.56	-138.90
Q2	10/13/05		21.29	6.99	762.00	18.00	2.82	-95.80
Q3	1/23/06		7.61	7.07	549.00	2.90	0.47	-100.80
Q4	5/4/06		17.16	7.14	746.00	-	0.48	-108.00
Q5	9/11/06		24.95	6.94	494.00	8.50	0.95	-89.90
Q6	2/13/07		3.24	7.22	534.32	40.34	8.84	-57.35
		AVERAGE	**17.27**	**6.97**	**698.55**	**14.31**	**2.35**	**-98.46**
Q1	8/2/05	1-MW-06A	28.49	6.91	857.00	6.90	0.03	-124.60
Q2	10/6/05		23.80	6.91	816.00	6.20	0.30	-104.40
Q3	1/19/06		8.29	7.22	611.00	1.60	0.21	-9.90
Q4	4/27/06		20.01	7.03	524.00	1.90	0.33	-143.10
Q5	9/7/06		25.40	6.69	642.00	5.80	0.22	-160.70
Q6	2/7/07		4.36	7.30	467.20	25.81	2.21	95.65
		AVERAGE	**18.39**	**7.01**	**652.87**	**8.04**	**0.55**	**-74.51**
Q1	8/10/05	1-MW-08A	29.44	10.23	955.00	9.00	1.53	-243.70
Q2	10/10/05		24.30	10.00	699.00	3.10	3.38	-157.40
Q3	1/18/06		3.08	8.08	773.00	10.30	8.91	89.90
Q4	4/28/06		15.34	8.76	529.00	7.30	5.15	-65.40
Q5	9/11/07		23.99	8.36	582.00	6.70	0.61	-146.50
Q6	2/9/07		2.67	8.26	279.54	38.11	1.62	174.66
		AVERAGE	**16.47**	**8.95**	**636.26**	**12.42**	**3.53**	**-58.07**
Q1	8/26/05	1-MW-10A	29.63	7.94	885.00	4.80	0.10	-113.80
Q2	10/10/05		23.69	7.09	950.00	9.60	1.02	-
Q3	1/17/06		6.04	7.57	657.00	6.80	0.95	191.10
Q4	4/28/06		15.64	7.42	551.00	12.10	0.38	-117.90
Q5	9/7/06		22.48	7.28	608.00	4.20	0.19	-119.80
Q6	2/8/07		3.17	7.84	498.92	45.23	1.71	-44.19
		AVERAGE	**16.78**	**7.52**	**691.65**	**13.79**	**0.73**	**-40.92**
Q1	8/3/05	2-MW-12A	30.88	7.14	0.78	6.40	0.44	-179.80
Q2	10/11/05		20.16	7.06	2.92	7.10	0.46	-113.00
Q3	1/23/06		7.85	7.56	1.28	0.60	0.36	-156.70
Q4	5/3/06		21.19	7.66	1023.00	0.90	0.30	-136.00
Q5	9/8/06		26.98	7.18	733.00	0.00	0.56	-153.40
Q6	2/8/07		4.63	7.70	627.88	31.27	7.24	-95.48
		AVERAGE	**18.62**	**7.38**	**398.14**	**7.71**	**1.56**	**-139.06**
Q1	8/26/05	2-MW-15A	34.15	6.42	1476.00	0.90	0.67	-137.60
Q2	10/13/05		18.99	6.80	976.00	54.10	1.15	-100.20
Q3	1/25/06		7.95	6.83	848.00	0.30	0.80	-99.40
Q4	5/5/06		23.40	6.69	1249.00	10.00	1.89	-54.00
Q5	9/12/07		24.32	6.91	876.00	21.00	0.49	-133.50
Q6	2/15/07		8.98	6.95	603.60	40.38	1.68	-74.63
		AVERAGE	**19.63**	**6.77**	**1004.77**	**21.11**	**1.11**	**-99.89**

Table 4-21
YSI Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Temp. °C	pH	Cond. (mS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
Q1	8/10/05	1-MW-18A	28.53	7.17	931.00	9.00	0.17	-124.70
Q2	10/6/05		20.31	6.95	1095.00	15.10	0.17	-128.50
Q3	1/18/06		9.61	7.58	660.00	0.10	0.20	-128.60
Q4	5/1/06		17.29	7.71	556.00	0.00	0.33	-159.00
Q5	9/7/06		26.92	6.04	691.00	0.00	0.34	-133.10
Q6	2/7/07		6.11	7.53	474.62	11.76	0.14	-107.45
		AVERAGE	**18.13**	**7.16**	**734.60**	**5.99**	**0.23**	**-130.23**
Q1	8/25/05	2-MW-19A	26.34	6.53	1.57	8.90	UL	-66.70
Q2	10/14/05		19.71	6.82	1.53	72.90	6.48	-102.30
Q3	1/23/06		7.45	6.68	1.55	14.90	0.89	-105.20
Q4	5/4/06		19.22	6.62	1450.00	6.70	0.64	-79.00
Q5	9/13/06		23.88	6.67	1313.00	60.70	1.69	-120.00
Q6	2/14/07		2.70	6.88	1345.52	62.04	LL	-37.66
		AVERAGE	**16.55**	**6.70**	**685.53**	**37.69**	**2.43**	**-85.14**
Q1	8/8/05	2-MW-20A	29.73	5.78	1.05	0.90	0.68	-44.20
Q2	10/13/05		20.47	6.88	1.06	73.40	0.25	-125.00
Q3	1/20/06		11.33	7.00	1.01	0.90	0.37	-131.50
Q4	5/3/06		18.95	6.98	806.00	0.00	0.13	-109.70
Q5	9/12/06		24.45	6.86	863.00	5.30	0.92	-143.20
Q6	2/9/07		1.75	7.31	900.74	1.72	LL	204.43
		AVERAGE	**17.78**	**6.80**	**428.81**	**13.70**	**0.47**	**-58.20**
Q1	8/10/05	1-MW-21A	26.87	6.52	967.00	0.90	0.47	-110.30
Q2	10/7/05		23.33	6.55	883.00	3.50	0.14	-88.30
Q3	1/19/06		9.47	6.88	841.00	10.00	0.18	-90.70
Q4	5/1/06		17.52	6.88	763.00	0.00	0.23	-127.40
Q5	9/7/06		24.43	6.69	908.00	0.30	0.23	-117.70
Q6	2/7/07		5.65	6.95	794.89	18.29	0.48	-73.78
		AVERAGE	**17.88**	**6.75**	**859.48**	**5.50**	**0.29**	**-101.36**
Q1	8/11/05	1-MW-22A	29.55	7.20	2871.00	9.70	0.11	-102.70
Q2	10/7/05		24.94	7.30	3330.00	6.10	0.22	-157.10
Q3	1/19/06		8.78	7.62	1844.00	5.10	0.29	-136.50
Q4	4/28/06		18.78	7.58	1372.00	0.00	0.40	-146.20
Q5	9/8/06		25.22	7.56	1155.00	2.00	0.40	-176.60
Q6	2/7/07		6.67	7.76	832.55	LL	LL	-173.98
		AVERAGE	**18.99**	**7.50**	**1900.76**	**4.58**	**0.28**	**-148.85**
Q1	8/10/05	2-MW-24A	27.87	11.34	838.00	0.90	1.99	120.00
Q2	10/10/05		22.07	10.93	469.00	9.30	0.26	-167.10
Q3	1/20/06		9.44	11.70	360.00	~4.5	0.52	-292.80
Q4	5/1/06		18.85	9.90	280.00	0.00	2.79	-24.30
Q5	9/8/06		26.28	10.16	635.00	0.60	0.13	-124.30
Q6	2/7/07		7.09	10.29	368.39	LL	1.95	-38.80
		AVERAGE	**18.60**	**10.72**	**491.73**	**2.70**	**1.27**	**-87.88**

Table 4-21
YSI Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Temp. °C	pH	Cond. (mS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
Q1	8/9/05	2-MW-26A	27.78	11.89	2.79	4.80	0.26	62.00
Q2	10/11/05		21.61	11.34	1.66	19.80	0.07	-312.60
Q3	1/24/06		7.71	11.57	1.11	15.10	0.31	-108.30
Q4	5/1/06		19.59	11.65	932.00	7.90	0.15	-235.60
Q5	9/11/06		23.96	12.02	1102.00	3.00	0.09	-306.10
Q6	2/8/07		3.52	11.18	819.48	41.43	LL	-261.37
		AVERAGE	**17.36**	**11.61**	**476.51**	**15.34**	**0.18**	**-193.66**
		A AQUIFER AVERAGE	**17.88**	**7.83**	**743.05**	**12.88**	**1.15**	**-102.03**
B Aquifer Wells								
Q1	8/26/05	2-MW-01B	23.20	6.46	1370.00	23.20	0.93	-90.35
Q2	10/4/05		23.20	6.63	1300.00	8.00	0.19	-71.40
Q3	1/26/06		8.36	6.69	1065.00	8.80	0.09	-75.40
Q4	5/4/06		19.20	6.69	1356.00		0.18	-110.00
Q5	9/14/06		21.79	8.71	1463.00	102.50	0.36	6.40
Q6	2/14/07		8.99	6.99	1733.38	25.61	1.54	230.49
		AVERAGE	**17.46**	**7.03**	**1381.23**	**33.62**	**0.55**	**-18.38**
Q1	7/18/05	2-MW-03B	24.80	6.33	1244.00	28.45	1.05	-101.85
Q2	10/4/05		22.60	6.68	1450.00	25.40	0.31	-107.40
Q3	1/24/06		14.78	6.11	1177.00	1.20	0.91	-40.90
Q4	5/4/06		19.96	5.79	1468.00	0.00	0.48	-12.80
Q5	9/12/06		23.38	6.32	1470.00	4.30	7.94	-50.90
Q6	2/14/07		4.62	6.16	1635.14	18.98	0.28	227.31
		AVERAGE	**18.36**	**6.23**	**1407.36**	**13.06**	**1.83**	**-14.42**
Q1	7/26/05	2-MW-04B	24.90	5.53	1840.00	--	0.57	-52.40
Q2	10/5/05		22.76	6.76	387.40	7.50	0.38	-83.70
Q3	1/23/06		9.91	6.86	3006.00	6.70	1.28	-192.90
Q4	5/3/06		16.80	6.73	2150.00	19.10	0.16	-101.00
Q5	9/12/06		23.79	6.86	2334.00	10.10	0.27	-101.40
Q6	2/8/07		6.02	6.77	2000.72	114.16	LL	-25.36
		AVERAGE	**17.36**	**6.59**	**1953.02**	**31.51**	**0.53**	**-92.79**
Q1	8/26/05	2-MW-05B	28.03	6.97	1647.00	518.20	1.04	-160.10
Q2	10/5/05		21.88	7.15	1711.00	4.00	0.63	-177.90
Q3	1/25/06		10.99	6.65	1516.00	4.00	4.28	-126.90
Q4	5/4/06		18.07	7.22	7.22	1.20	0.66	-134.10
Q5	9/12/06		22.12	7.16	1705.00	2.30	1.55	-182.20
Q6	2/14/07		7.29	7.20	1270.02	13.88	0.00	177.90
		AVERAGE	**18.06**	**7.06**	**1309.37**	**90.60**	**1.36**	**-100.55**
Q1	8/26/05	1-MW-07B	28.26	6.73	812.00	3.80	0.15	-172.20
Q2	10/6/05		22.50	6.98	660.00	5.60	0.22	-129.30
Q3	1/18/06		12.47	7.14	476.00	10.00	0.32	-135.60
Q4	4/28/06		14.60	7.00	638.00	0.80	1.66	-97.10
Q5	9/7/06		24.55	6.53	646.00	6.00	0.28	-153.50
Q6	2/6/07		4.89	7.17	682.20	11.60	0.58	-78.95
		AVERAGE	**17.88**	**6.93**	**652.37**	**6.30**	**0.54**	**-127.78**

Table 4-21
YSI Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Temp. °C	pH	Cond. (mS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
Q1	8/3/05	1-MW-09B	24.80	6.51	664.00	9.00	0.09	-138.70
Q2	10/5/05		22.79	6.41	558.00	2.50	0.84	-74.20
Q3	1/17/06		7.65	6.72	653.00	11.50	0.22	-92.60
Q4	4/27/06		14.37	6.73	554.00	0.00	1.30	-91.90
Q5	9/7/06		21.02	6.64	505.00	2.90	2.72	-99.90
Q6	2/6/07		9.17	6.74	566.36	20.29	NM	-81.61
		AVERAGE	**16.63**	**6.63**	**583.39**	**7.70**	**1.03**	**-96.49**
Q1	8/9/05	1-MW-11B	22.58	11.49	1224.00	9.00	0.07	-359.90
Q2	10/6/05		21.89	11.17	910.00	1.90	0.29	-215.90
Q3	1/17/06		10.06	11.89	146.90	8.40	0.29	-232.00
Q4	4/27/06		18.50	11.69	1015.00	3.40	0.01	-264.40
Q5	9/7/06		19.94	11.51	1010.00	0.00	0.07	-236.60
Q6	2/7/07		9.75	11.80	939.87	0.79	0.25	-304.95
		AVERAGE	**17.12**	**11.59**	**874.30**	**3.92**	**0.16**	**-268.96**
Q1	8/12/05	3-MW-13B	25.35	4.97	3.45	3.20	0.85	17.90
Q2	10/13/05		18.08	5.62	3.40	8.20	0.35	14.60
Q3	1/24/06		13.84	5.44	3.47	6.50	0.51	68.80
Q4	5/2/06		15.64	5.66	3302.00	4.00	0.58	31.50
Q5	9/12/06		20.42	5.49	2101.00	8.60	0.75	-22.80
Q6	2/9/07		8.88	5.68	3441.34	29.90	LL	226.89
		AVERAGE	**17.04**	**5.48**	**1475.78**	**10.07**	**0.61**	**56.15**
Q1	8/12/05	3-MW-14B	24.69	7.05	2.71	9.00	0.14	-102.40
Q2	10/13/05		19.22	7.03	3.23	0.00	0.34	-107.00
Q3	1/25/06		9.80	7.31	2.43	2.90	--	-126.00
Q4	5/2/06		15.82	7.30	2454.00	2.50	0.34	-130.40
Q5	9/13/06		20.37	7.41	2498.00	0.70	0.28	-121.70
Q6	2/9/07		9.72	7.33	1904.34	80.90	0.00	-79.31
		AVERAGE	**16.60**	**7.24**	**1144.12**	**16.00**	**0.22**	**-111.14**
Q1	8/11/05	2-MW-16B	25.52	8.80	1902.00	10.20	0.46	-399.80
Q2	10/10/05		23.73	9.00	1923.00	18.30	0.07	-449.10
Q3	1/20/06		12.40	9.76	1411.00	13.80	0.15	-367.60
Q4	5/1/06		17.52	8.86	17.55	3.70	0.05	-375.90
Q5	9/8/06		25.41	9.05	3006.00	6.80	0.07	-374.60
Q6	2/8/07		6.50	8.82	1320.51	40.49	0.00	-121.94
		AVERAGE	**18.51**	**9.05**	**1596.68**	**15.55**	**0.13**	**-348.16**
Q1	8/10/05	1-MW-17B	24.30	6.57	810.00	9.60	0.13	-108.40
Q2	10/7/05		22.63	6.39	598.00	1.10	0.27	-105.10
Q3	1/18/06		10.75	6.66	783.00	6.10	0.19	-84.70
Q4	5/1/06		15.71	6.59	715.00	4.00	0.49	-109.10
Q5	9/8/06		22.75	6.30	593.00	6.00	0.49	-100.80
Q6	2/7/07		10.51	6.68	678.44	38.46	LL	-119.77
		AVERAGE	**17.78**	**6.53**	**696.24**	**10.88**	**0.31**	**-104.65**

Table 4-21
YSI Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Temp. ºC	pH	Cond. (mS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
Q1	8/9/05	2-MW-23B	21.17	6.90	1108.00	5.60	0.53	-132.90
Q3	1/20/06		13.87	6.98	1030.00	5.00	0.92	-131.90
Q4	5/3/06		18.45	7.07	720.00	0.00	0.10	-107.80
Q5	9/11/06		23.85	6.96	905.00	1.00	0.22	-157.60
Q6	2/12/07		10.32	7.14	954.07	7.74	0.00	-52.34
		AVERAGE	**17.53**	**7.01**	**943.41**	**3.87**	**0.35**	**-116.51**
		B AQUIFER AVERAGE	**17.53**	**7.28**	**1171.27**	**20.14**	**0.65**	**-111.91**

C Aquifer Wells								
Q1		2-MW-25C	16.33	12.22	5081.00	0.90	0.65	-161.00
Q2	11/17/05		18.09	7.33	2.59	2.00	4.90	-249.60
Q3	1/24/06		15.12	11.66	5.38	0.00	2.90	-81.40
Q5	9/11/06		21.57	6.44	4298.00	6.10	0.30	-100.10
Q6	2/8/07		11.69	6.40	4994.94	40.72	LL	-162.26
		AVERAGE	**16.56**	**8.81**	**2876.38**	**9.94**	**2.19**	**-150.87**

Notes:

ºC = Degrees Celsius
DO = Dissolved Oxygen
LL = Lower Limit, which is 0 for turbidity and D.O.
mg/L = Milligrams per Liter
mV = Millivolts
ORP = Oxidation Reduction Potential
NM = Not Measured (dry well)
NTU = Nephelometric Turbidity Unit
UL = Upper Limit, which is 9.1 for D.O.
mS/cm^3 = micro Siemens per cubic centimeters
LLs and ULs are not calculated into the average

Table 4-22
HACH Kit Water Quality Data, Operable Units 1 and 2

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
A Aquifer Wells							
Q1	8/3/05	2-MW-02A	0.76	0.08	0.06	2.80	
Q2	10/13/05		0.28	0.06	0.04	1.20	
Q3	1/23/06		1.73	0.02	0.00	0.20	
Q4	5/4/06		1.08	0.04	0.03	1.60	
Q5	9/11/06		3.30	0.05	0.02	0.40	Fe2+ possibly > than 3.3
Q6	2/13/07		0.16	0.07	0.01	0.00	
		AVERAGE	**1.22**	**0.05**	**0.03**	**1.03**	
Q1	8/2/05	1-MW-06A	2.76	0.03	0.00	3.20	
Q2	10/6/05		2.67	0.05	0.00	2.80	
Q3	1/19/06		1.43	0.00	0.00	0.60	
Q4	4/27/06		0.04	0.00	0.00	1.00	
Q5	9/7/06		2.62	0.03	0.00	0.00	
Q6	2/7/07		1.32	0.01	0.01	0.00	
		AVERAGE	**1.81**	**0.02**	**0.00**	**1.27**	
Q1	8/10/05	1-MW-08A	0.00	0.07	0.02	1.80	
Q2	10/10/05		0.04	0.31	0.06	1.00	
Q3	1/18/06		0.03	0.09	0.06	0.40	
Q4	4/28/06		0.03	0.07	0.05	1.60	
Q5	9/11/07		0.05	0.07	0.01	0.50	
Q6	2/9/07		0.02	0.06	0.02	0.00	
		AVERAGE	**0.03**	**0.11**	**0.04**	**0.88**	
Q2	10/10/05	1-MW-10A	0.05	0.09	0.04	2.60	
Q3	1/17/06		0.01	0.03	0.01	0.40	
Q4	4/28/06		0.03	0.02	0.01	0.60	
Q5	9/7/06		0.95	0.05	0.00	0.50	
Q6	2/8/07		0.05	0.17	0.01	0.50	
		AVERAGE	**0.22**	**0.07**	**0.01**	**0.92**	
Q1	8/3/05	2-MW-12A	0.09	0.02	0.00	2.20	
Q2	10/11/05		2.59	0.02	0.00	1.20	
Q3	1/23/06		1.49	0.05	0.00	0.40	
Q4	5/3/06		0.03	0.01	0.01	1.20	
Q5	9/8/06		2.59	0.02	0.00	0.50	
Q6	2/8/07		0.06	0.02	0.01	0.50	
		AVERAGE	**1.14**	**0.02**	**0.00**	**1.00**	
Q1	8/26/05	2-MW-15A					
Q2	10/13/05		3.30	0.09	0.00	1.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q3	1/25/06		2.78	0.02	0.01	0.20	
Q4	5/5/06		3.30	0.00	0.00	1.80	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/12/07		3.30	0.03	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q6	2/15/07		NM	NM	NM	NM	Well was dry, no sampling
		AVERAGE	**3.17**	**0.04**	**0.00**	**0.75**	
Q1	8/10/05	1-MW-18A	0.08	0.02	0.00	2.40	
Q2	10/6/05		0.09	0.03	0.00	2.40	
s consistent	1/18/06		1.23	0.00	0.00	0.80	
Q4	5/1/06		0.27	0.03	0.08	0.60	
Q5	9/7/06		0.75	0.03	0.00	0.50	
Q6	2/7/07		0.33	0.03	0.01	0.50	
		AVERAGE	**0.46**	**0.02**	**0.01**	**1.20**	

Table 4-22
HACH Kit Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
Q1	8/25/05	2-MW-19A	2.65	0.02	0.00	1.00	
Q2	10/14/05		3.30	0.16	0.00	1.00	Fe2+ possibly > than 3.3
Q3	1/23/06		0.89	0.06	0.05	0.20	
Q4	5/4/06		3.30	0.02	0.00	0.80	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/13/06		2.97	0.13	0.00	0.00	
Q6	2/14/07		2.00	0.53	0.00	0.00	
		AVERAGE	**2.52**	**0.15**	**0.01**	**0.50**	
Q1	8/8/05	2-MW-20A	3.06	0.03	0.00	1.00	
Q2	10/13/05		3.30	0.03	0.00	0.80	
Q3	1/20/06		2.81	0.00	0.01	0.60	
Q4	5/3/06		3.30	0.04	0.00	1.40	Fe2+ possibly > than 3.3
Q5	9/12/06		3.05	0.04	0.00	0.00	
Q6	2/9/07		2.62	0.03	0.00	0.00	
		AVERAGE	**3.02**	**0.03**	**0.00**	**0.63**	
Q1	8/10/05	1-MW-21A	3.30	0.02	0.00	2.80	Fe2+ possibly > than 3.3
Q2	10/7/05		3.30	0.04	0.00	1.60	
Q3	1/19/06		1.51	0.01	0.00	0.60	
Q4	5/1/06		3.30	NM	0.06	1.60	Fe2+ possibly > than 3.3. Not enough reagent for sulfide analysis
Q5	9/7/06		3.30	0.02	0.00	0.00	
Q6	2/7/07		3.30	0.00	0.00	0.00	Fe2+ possibly > than 3.3
		AVERAGE	**3.00**	**0.02**	**0.01**	**1.10**	
Q1	8/11/05	1-MW-22A	0.34	0.02	0.01	1.60	
Q2	10/7/05		0.67	0.11	0.00	1.40	
Q3	1/19/06		0.80	0.06	0.00	0.20	
Q4	4/28/06		2.00	0.20	0.00	1.00	
Q5	9/8/06		0.10	0.04	0.00	0.00	
Q6	2/7/07		0.13	0.22	0.00	0.00	
		AVERAGE	**0.67**	**0.11**	**0.00**	**0.70**	
Q1	8/10/05	2-MW-24A	0.03	0.37	0.01	1.20	
Q2	10/10/05		0.02	0.51	0.01	1.00	
Q3	1/20/06		0.04	0.22	0.00	0.40	
Q4	5/1/06		0.01	0.57	0.05	3.20	
Q5	9/8/06		0.00	0.45	0.05	1.00	
Q6	2/7/07		0.00	0.02	0.00	0.00	
		AVERAGE	**0.02**	**0.36**	**0.02**	**1.13**	
Q1	8/9/05	2-MW-26A	2.72	0.32	0.18	>80	
Q2	10/11/05		0.00	0.80	0.00	2.00	
Q3	1/24/06		0.03	0.25	0.00	0.80	
Q4	5/1/06		0.00	NM	0.00	NM	Sample too dark for H2O2 analysis. Not enough reagent for sulfide analysis.
Q5	9/11/06		0.00	0.80	0.00	0.00	"Limit" on S2-
Q6	2/8/07		0.00	0.67	0.00	2.00	
		AVERAGE	**0.46**	**0.57**	**0.03**	**1.20**	
		A AQUIFER AVERAGE	**1.33**	**0.12**	**0.01**	**0.92**	

B Aquifer Wells							
Q1	8/26/05	2-MW-01B					Thick product
Q2	10/4/05		3.30	0.04	0.00	1.40	Thick product
Q3	1/26/06		3.30	0.01	0.11	0.60	

Table 4-22
HACH Kit Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
Q4	5/4/06	2-MW-01B	3.30	0.05	0.00	2.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/14/06		0.00	0.55	0.00	0.00	
Q6	2/14/07		1.52	0.01	0.00	0.00	
		AVERAGE	**2.28**	**0.13**	**0.02**	**0.80**	
Q1	7/18/05	2-MW-03B	3.30	0.12	0.05		
Q2	10/4/05		2.79	0.05	0.01	1.20	
Q3	1/24/06		2.73	0.05	0.13	0.60	
Q4	5/4/06		3.30	0.03	0.00	1.60	Fe2+ possibly > than 3.3
Q5	9/12/06		3.30	0.00	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/14/07		2.50	0.02	0.03	0.00	
		AVERAGE	**2.99**	**0.05**	**0.04**	**0.68**	
Q1	7/26/05	2-MW-04B	0.05	0.01	0.06		
Q2	10/5/05		2.94	0.04	0.00	2.80	
Q3	1/23/06		0.99	0.10	0.01	0.40	
Q4	5/3/06		2.97	0.03	0.00	1.40	
Q5	9/12/06		2.74	0.02	0.00	0.00	
Q6	2/8/07		2.04	0.02	0.00	0.00	
		AVERAGE	**1.96**	**0.04**	**0.01**	**0.92**	
Q2	10/5/05	2-MW-05B	1.68	0.07	0.00	3.20	
Q3	1/25/06		2.02	0.04	0.00	0.60	
Q4	5/4/06		3.30	0.04	0.00	2.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/12/06		2.99	0.05	0.00	0.00	
Q6	2/14/07		1.49	0.02	0.00	0.00	
		AVERAGE	**2.30**	**0.04**	**0.00**	**1.16**	
Q2	10/6/05	1-MW-07B	3.30	0.04	0.03	1.20	
Q3	1/18/06		2.23	0.02	0.00	0.60	
Q4	4/28/06		3.15	0.20	0.00	1.00	
Q5	9/7/06		3.30	0.01	0.00	0.50	
Q6	2/6/07		1.46	0.03	0.00	0.00	
		AVERAGE	**2.69**	**0.06**	**0.01**	**0.66**	
Q1	8/3/05	1-MW-09B	0.91	0.02	0.00	1.60	
Q2	10/5/05		2.98	0.04	0.00	1.80	
Q3	1/17/06		0.52	0.03	0.00	1.00	
Q4	4/27/06		2.42	0.01	0.00	1.20	NO2 possibly between 0 and 0.002
Q5	9/7/06		2.68	0.06	0.00	0.00	
Q6	2/6/07		1.34	0.06	0.01	0.00	
		AVERAGE	**1.81**	**0.04**	**0.00**	**0.93**	
Q1	8/9/05	1-MW-11B	0.22	0.80	0.01	>16	
Q2	10/6/05		0.05	0.80	0.01	0.00	
Q3	1/17/06		0.01	0.80	0.01	>45	
Q4	4/27/06		0.07	0.80	0.00	>7.0	35 drops - no color change
Q5	9/7/06		0.05	0.80	0.00	0.00	
Q6	2/7/07		0.07	0.80	0.00	0.00	
		AVERAGE	**0.08**	**0.80**	**0.00**	**0.00**	
Q1	8/12/05	3-MW-13B	0.45	0.01	0.02	ND	
Q2	10/13/05		3.30	0.02	0.01	1.00	
Q3	1/24/06		3.30	0.08	0.00	0.60	NO2 possibly between 0 and 0.002
Q4	5/2/06		3.30	NM	0.00	1.00	Fe2+ possibly > than 3.3. Not enough reagent fro sulfide analysis.

Table 4-22
HACH Kit Water Quality Data, Operable Units 1 and 2
(cont.)

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
Q5	9/12/06	3-MW-13B	3.30	0.04	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/9/07		2.91	0.02	0.01	0.00	
		AVERAGE	**2.76**	**0.03**	**0.01**	**0.52**	
Q1	8/12/05	3-MW-14B	0.11	0.00	0.25	0.40	
Q2	10/13/05		2.84	0.03	0.00	1.20	NO2 possibly between 0 and 0.002
Q3	1/25/06		2.15	0.02	0.00	0.60	NO2 possibly between 0 and 0.002
Q4	5/2/06		2.15	NM	0.02	0.60	Not enough reagent for sulfide analysis.
Q5	9/13/06		0.03	0.02	0.00	0.50	
Q6	2/9/07		1.24	0.04	0.00	0.00	
		AVERAGE	**1.42**	**0.02**	**0.04**	**0.55**	
Q1	8/11/05	2-MW-16B	0.17	0.80	0.00	--	Sample too dark to analyze for H2O2; "limit" on S2 & No2
Q2	10/10/05		0.00	0.80	0.00	--	Dark coffee-colored sample
Q3	1/20/06		0.00	0.80	0.00	>6	No color change after the addition of 30 drops
Q4	5/1/06		0.00	0.80	0.00	NM	Sample too dark to analyze for H2O2
Q5	9/8/06		0.01	0.80	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/8/07		0.00	0.80	0.00	0.00	"Limit" on S^{2-}
		AVERAGE	**0.03**	**0.80**	**0.00**	**0.00**	
Q1	8/10/05	1-MW-17B	3.30	0.02	0.00	3.20	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q2	10/7/05		3.30	0.04	0.00	2.20	
Q3	1/18/06		1.97	0.02	0.00	0.80	
Q4	5/1/06		3.30	0.03	0.00	1.20	Fe2+ possibly > than 3.3
Q5	9/8/06		3.10	0.11	0.00	0.00	
Q6	2/7/07		3.30	0.07	0.00	0.00	
		AVERAGE	**3.05**	**0.05**	**0.00**	**1.23**	
Q1	8/9/05	2-MW-23B	1.91	0.03	0.00	1.80	
Q3	1/20/06		1.34	0.07	0.01	0.60	
Q4	5/3/06		3.30	0.04	0.00	1.00	Fe2+ possibly > than 3.3
Q5	9/11/06		2.80	0.02	0.00	0.50	
Q6	2/12/07		2.68	0.03	0.00	0.00	
		AVERAGE	**2.41**	**0.04**	**0.00**	**0.78**	
		B AQUIFER AVERAGE	**1.87**	**0.20**	**0.01**	**0.74**	
C Aquifer Wells							
Q3	1/24/06	2-MW-25C	0.13	0.02	0.23	0.40	
Q4	5/3/06		0.03	0.01	0.03	0.40	
Q5	9/11/06		3.30	0.01	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q6	2/8/07		3.30	0.01	0.00	0.00	Fe2+ possibly > than 3.3
		AVERAGE	**1.69**	**0.01**	**0.06**	**0.20**	

Notes:

mg/L = Milligrams per Liter
ND = Not Determined
NM = Not Measured (dry well)

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2

			Analyte	CHLORIDE		FLUORIDE		NITRATE AS N		NITRATE/NITRITE AS N		ORTHOPHOSPHATE AS P		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
			NJDEP WQC (mg/L)	250		NA		10		NA		NA		250		NA		NA	
			Region 6 PRG (mg/L)	**NA**		**2.19**		**10**		**NA**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**		**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
A Aquifer																			
1-MW-06-GU-P-09	10/4/04	NA		15	J	2.6		0.2	UJ			0.2	UJ	16		320	J		
1-MW-06-GU-P-09	10/13/04	NA		14	J	2.9	J	0.2	U			0.2	U	7.1	J	370	J		
1-MW-06-GU-P-02	8/2/05	1		11	J	3.4				0.05	U			12		320		0.27	J
1-MW-06-GU-P-02	10/6/05	2		11	J	3.2				0.01	U			2.2		350		0.26	
1-MW-06-GU-P-02	1/19/06	3		8.8		2.3				0.025				11		260		0.16	J
1-MW-06-GU-P-02	4/27/06	4		9		2.5				0.044				20		240		0.19	
1-MW-06-GU-P-02	9/7/06	5		8.3		2.7				0.01	U			1.8		300		0.3	
1-MW-06-GU-P-02	2/8/07	6								0.1								0.058	
1-MW-06-GU-P-02	2/13/07	7		8.3		1.2								13		220			
			AVERAGE	**10.68**		**2.60**		**0.20**		**0.04**		**0.20**		**10.39**		**297.50**		**0.21**	
1-MW-08-GU-P-02	10/11/04	NA		12	J	0.51	J	0.4	U			0.4	U	44	J	380	J		
1-MW-08-GU-P-02	8/10/05	1		6.3	J	0.81	J			0.011				44	J	230	J	0.066	J
1-MW-08-GU-P-02	10/10/05	2		7.6		0.35				0.11				200		370		0.44	
1-MW-08-GU-P-02	1/18/06	3		3.5	J	1				0.055				53		230		0.2	J
1-MW-08-GU-P-02	4/28/06	4		3.2		1.2				0.19				54		220		0.12	
1-MW-08-GU-P-02	9/11/06	5		3.3		0.86				0.11				75		390		0.094	
1-MW-08-GU-P-02	2/13/07	6		3.1		1.4				0.12				30		250		0.16	
			AVERAGE	**5.57**		**0.88**		**0.40**		**0.10**		**0.40**		**71.43**		**295.71**		**0.18**	
1-MW-10-GU-P-02	10/21/04	NA		17	J	1.4		0.2	U			0.2	U	90	J	240	J		
1-MW-10-GU-P-02	8/16/05	1		44	J	1.9	J			0.01	U			25		280		0.79	J
1-MW-10-GU-P-02	10/10/05	2		14		1.2				0.89				190		260		0.074	
1-MW-10-GU-P-02	1/17/06	3		9.5	J	1.2				0.11				110		150		0.16	J
1-MW-10-GU-P-02	4/28/06	4		7.4		0.77				0.28				91		190		0.05	U
1-MW-10-GU-P-02	9/7/06	5		9		1.2				0.021				78		230		0.29	
1-MW-10-GU-P-02	2/8/07	6								0.46								0.5	
1-MW-10-GU-P-02	2/9/07	6		14		1.5								33		190			
			AVERAGE	**16.41**		**1.31**		**0.20**		**0.30**		**0.20**		**88.14**		**220.00**		**0.31**	
1-MW-18-GU-P-09	10/5/04	NA		14	J	17	J	0.2	UJ			0.2	UJ	56	J	270	J		
1-MW-18-GU-P-09	10/13/04	NA		9	J	21	J	0.2	U			0.23	J	60	J	270	J		
1-MW-18-GU-P-02	8/10/05	1		12	J	18	J			0.01	U			15	J	300	J	0.062	J
2-MW-18-GU-P-02	10/6/05	2		15	J	16				0.012				5		360		0.072	
1-MW-18-GU-P-02	1/18/06	3		5.8	J	15				0.011				13		260		0.05	U
1-MW-18-GU-P-02	5/1/06	4		6.4	J	17	J			1				15		270		0.05	U
1-MW-18-GU-P-02	9/7/06	5		6.2		15				0.14				11		320		0.05	U

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE		FLUORIDE		NITRATE AS N		NITRATE/NITRITE AS N		ORTHOPHOSPHATE AS P		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		10		NA		NA		250		NA		NA	
Region 6 PRG (mg/L)			**NA**		**2.19**		**10**		**NA**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
A Aquifer Cont.																		
1-MW-18-GU-P-02	2/7/07	6							0.025								0.05	U
is CF is consistent with th	2/15/07	6	6.5		18								14		240			
AVERAGE			**9.36**		**17.13**		**0.20**		**0.20**		**0.22**		**23.63**		**286.25**		**0.06**	
1-MW-21-GU-P-02	8/10/05	1	51	J	0.42	J			0.2	U			38	J	310	J	0.05	U
1-MW-21-GU-P-02	10/7/05	2	41	J	0.47				0.05	U			39		430		0.12	
1-MW-21-GU-P-02	1/19/06	3	39		0.35				0.063				12		300		0.066	J
1-MW-21-GU-P-02	5/1/06	4	44	J	0.45	J			0.11				8.8		320		0.1	
1-MW-21-GU-P-02	9/7/06	5	40		0.45				0.036				12		320		0.1	
1-MW-21-GU-P-02	2/7/07	6	35		0.5				0.029				4.2		330		0.078	
AVERAGE			**41.67**		**0.44**		**N/A**		**0.08**		**N/A**		**19.00**		**335.00**		**0.09**	
1-MW-22-GU-P-02	8/11/05	1	610	J	16	J			0.05	U			61	J	370		0.2	J
1-MW-22-GU-P-02	10/7/05	2	660	J	18				0.016				47		440		0.25	
1-MW-22-GU-P-02	1/19/06	3	300		12				0.021				44		300		0.18	J
1-MW-22-GU-P-02	4/28/06	4	240		12				0.019				24		270		0.18	
1-MW-22-GU-P-02	9/8/06	5	180		13				0.028				15		340		0.27	
1-MW-22-GU-P-02	2/7/07	6							0.086								0.23	
1-MW-22-GU-P-02	2/14/07	6	120		8.8								5.2		240			
AVERAGE			**351.67**		**13.30**		**N/A**		**0.04**		**N/A**		**32.70**		**326.67**		**0.22**	
2-MW-02-GU-P-02	10/25/04	NA	48	J	4.1	J	0.21	J			0.2	UJ	140	J	430	J		
2-MW-02-GU-P-02	8/3/05	1	34	J	4.7				0.032				15		520		0.15	J
2-MW-02-GU-P-02	10/14/05	2	19	J	6				0.01	U			16		390		0.079	
2-MW-02-GU-P-02	1/24/06	3	6.9	J	6.2				0.11				18		260		0.05	U
2-MW-02-GU-P-02	9/11/06	5	18		5.1				0.18				10		340		0.05	U
2-MW-02-GU-P-02	2/9/07	6	10		4.4				0.11				5.4		230		0.066	
AVERAGE			**22.65**		**5.08**		**N/A**		**0.09**		**N/A**		**34.07**		**361.67**		**0.08**	
2-MW-12-GU-P-09	10/6/04	NA	22	J	1.4	J	0.2	U			0.2	U	27	J	240	J		
2-MW-12-GU-P-02	8/3/05	1	37	J	1.6				0.01	U			14		330		0.22	J
2-MW-12-GU-P-02	10/11/05	2	660		1.7				0.01	U			66		270		0.06	
2-MW-12-GU-P-02	1/23/06	3	190	J	1.3				0.085				34		220		0.14	J
2-MW-12-GU-P-02	5/3/06	4	110	J	1.8	J			0.056				15		280		0.26	J
2-MW-12-GU-P-02	9/8/06	5	36		2				0.08				7.5		330		0.14	
2-MW-12-GU-P-02	2/8/07	6	36		1.6								11		250			
2-MW-12-GU-P-02	2/13/07	6							0.01	U							0.15	
AVERAGE			**155.86**		**1.63**		**N/A**		**0.04**		**N/A**		**24.93**		**274.29**		**0.16**	

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE		FLUORIDE		NITRATE AS N		NITRATE/NITRITE AS N		ORTHOPHOSPHATE AS P		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		10		NA		NA		250		NA		NA	
Region 6 PRG (mg/L)			**NA**		**2.19**		**10**		**NA**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
A Aquifer Cont.																		
2-MW-15-GU-P-02	10/15/04	NA	78	J	3.5		0.2	U			0.2	U	54		480	J		
2-MW-15-GU-P-02	8/10/05	1	80	J	4.2	J			0.1	U			29	J	560	J	0.05	U
2-MW-15-GU-P-02	10/14/05	2	31	J	2.8				0.01	U			49		400		0.11	
2-MW-15-GU-P-02	5/9/06	4	50	J	3.2				0.063				52		500		0.05	U
2-MW-15-GU-P-02	9/13/06	5	48		3.4				0.38				19		500		0.063	
AVERAGE			**57.40**		**3.42**		**N/A**		**0.14**		**N/A**		**40.60**		**488.00**		**0.07**	
2-MW-19-GU-P-02	8/25/05	1	280	J	0.69	J			0.044				8		340		0.05	U
2-MW-19-GU-P-02	10/14/05	2							0.01	U							0.2	
2-MW-19-GU-P-02	1/24/06	3	270	J	0.59				0.042				2	U	330		0.11	J
2-MW-19-GU-P-02	9/13/06	5	180		0.44				0.091				1	U	380		0.13	
2-MW-19-GU-P-02	2/14/07	6	230		0.33				0.05	U			2	U	350		0.2	
AVERAGE			**240.00**		**0.51**		**N/A**		**0.05**		**N/A**		**3.25**		**350.00**		**0.14**	
2-MW-20-GU-P-02	8/9/05	1	160	J	6.4	J			0.01	U			3.9	J	190		0.074	J
2-MW-20-GU-P-02	10/13/05	2	160	J	6.7				0.01	U			2.9		190		0.05	U
2-MW-20-GU-P-02	1/23/06	3	140	J	5.4				0.072				3.8		200		0.11	J
2-MW-20-GU-P-02	5/3/06	4	160	J	4.8	J			0.16				9.5		210		0.14	J
2-MW-20-GU-P-02	9/12/06	5	130		6.4				0.11	N			4.1		200		0.23	
2-MW-20-GU-P-02	2/9/07	6	140		4.7				0.01	U			1	U	210		0.12	
AVERAGE			**148.33**		**5.73**		**N/A**		**0.06**		**N/A**		**4.20**		**200.00**		**0.12**	
2-MW-24-GU-P-02	8/10/05	1	13	J	0.36	J			0.018				40	J	200	J	0.076	J
2-MW-24-GU-P-02	10/10/05	2	9.3		0.42				0.01	U			45		160		0.05	U
2-MW-24-GU-P-02	1/20/06	3	8	J	0.31				0.014				14		140		0.11	J
2-MW-24-GU-P-02	5/1/06	4	6.7	J	0.31	J			0.012				7.9		150		0.081	
2-MW-24-GU-P-02	9/8/06	5	9.9		0.32				0.6				14		160		0.08	
2-MW-24-GU-P-02	2/8/07	6	8.2		0.37				0.28				8		150		0.05	U
AVERAGE			**9.18**		**0.35**		**N/A**		**0.16**		**N/A**		**21.48**		**160.00**		**0.07**	
2-MW-26-GU-P-02	8/9/05	1	94	J	1	J			0.098				160	J	600		0.29	J
2-MW-26-GU-P-02	10/12/05	2	62	J	2.7				0.01	U			110		450		0.36	
2-MW-26-GU-P-02	1/24/06	3	69	J	1.1				0.023				26		390		0.34	J
2-MW-26-GU-P-02	5/1/06	4	69	J	1.9	J			0.031				30		380		0.43	
2-MW-26-GU-P-02	9/11/06	5	61		1.3				0.021				32		390		0.51	
2-MW-26-GU-P-02	2/8/07	6	68		0.84				0.047				31		290		0.51	
AVERAGE			**70.50**		**1.47**		**N/A**		**0.04**		**N/A**		**64.83**		**416.67**		**0.41**	
A AQUIFER AVERAGE			**79.47**		**4.41**		**0.22**		**0.10**		**0.23**		**34.60**		**302.93**		**0.17**	

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE	FLUORIDE	NITRATE AS N	NITRATE/NITRITE AS N	ORTHOPHOSPHATE AS P	SULFATE (SO4)	TOTAL ALKALINITY As CaCO3	TOTAL PHOSPHORUS
NJDEP WQC (mg/L)			250	NA	10	NA	NA	250	NA	NA
Region 6 PRG (mg/L)			**NA**	**2.19**	**10**	**NA**	**NA**	**NA**	**NA**	**0.00073**
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**
B Aquifer										
1-MW-07-GU-P-13	10/4/04	NA	46 J	0.62	0.2 UJ		0.28 J	1.3	310 J	
1-MW-07-GU-P-14	10/13/04	NA	34 J	0.32 J	0.2 U		0.2 U	1 U	340 J	
1-MW-07-GU-P-02	8/2/05	1	37 J	0.65		0.05 U		1 U	280	0.15 J
1-MW-07-GU-P-02	10/6/05	2	29 J	0.72		0.05 U		1 U	270	0.14
1-MW-07-GU-P-02	1/18/06	3	29 J	0.62		0.016		1 U	280	0.11 J
1-MW-07-GU-P-02	4/28/06	4	31	0.51		0.12		1 U	290	0.11
1-MW-07-GU-P-02	9/7/06	5	26	0.68		0.026		1 U	280	0.12
1-MW-07-GU-P-02	2/6/07	6	24	0.59				1 U	300	
1-MW-07-GU-P-02	2/7/07	6				0.01 U				0.18
AVERAGE			**32.00**	**0.59**	**0.20**	**0.05**	**0.24**	**1.04**	**293.75**	**0.14**
1-MW-09-GU-P-13	10/5/04	NA	17 J	2.1 J	0.2 UJ		0.2 UJ	7 J	230 J	
1-MW-09-GU-P-14	10/13/04	NA	11 J	2.7 J	0.2 U		0.2 U	3.5 J	250 J	
1-MW-09-GU-P-02	8/3/05	1	11 J	3.1		0.2 U		1.7	260	0.077 J
1-MW-09-GU-P-02	10/5/05	2	12 J	3		0.01 U		7.8	230	0.07
1-MW-09-GU-P-02	1/17/06	3	8.5 J	2.7		0.031		1 U	270	0.052 J
1-MW-09-GU-P-02	4/27/06	4	9.3	2.7		0.052		1 U	260	0.057
1-MW-09-GU-P-02	9/7/06	5	7.5	3.2		0.078		1 U	260	0.05 U
1-MW-09-GU-P-02	2/6/07	6	9.2	2.8				1 U	280	
1-MW-09-GU-P-02	2/7/07	6				0.01 U				0.087
AVERAGE			**10.69**	**2.79**	**N/A**	**0.06**	**N/A**	**3.00**	**255.00**	**0.07**
1-MW-11-GU-P-02	10/13/04	NA	22 J	1.2 J	0.2 U		0.2 U	76 J	180 J	
1-MW-11-GU-P-02	8/9/05	1	28 J	0.66 J		0.01 U		34 J	230	0.05 U
2-MW-11-GU-D-02	10/6/05	2	42 J	0.55		0.01 U		41	190	0.054
2-MW-11-GU-D-02	1/17/06	3	20 J	0.45		0.013		74	210	0.05 U
2-MW-11-GU-D-02	4/27/06	4	26	0.58		0.019		56	200	0.05 U
2-MW-11-GU-D-02	9/7/06	5	36	0.76		0.045		42	190	0.05 U
2-MW-11-GU-D-02	2/7/07	6	15	0.58		0.1		45	180	0.14
AVERAGE			**27.00**	**0.68**	**N/A**	**0.03**	**N/A**	**52.57**	**197.14**	**0.07**
1-MW-17-GU-P-05	10/13/04	NA	30 J	1.3 J	0.2 U		0.2 U	19 J	260 J	
1-MW-17-GU-P-13	10/5/04	NA	44 J	0.57 J	0.2 UJ		0.2 UJ	38 J	220 J	
1-MW-17-GU-P-02	8/10/05	1	27 J	5.7 J		0.5 U		15 J	230 J	0.19 J
1-MW-17-GU-P-02	10/7/05	2	31 J	6.8		0.05 U		17	210	0.21
1-MW-17-GU-P-02	1/18/06	3	25 J	7.6		0.083		13	230	0.18 J

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE		FLUORIDE		NITRATE AS N		NITRATE/NITRITE AS N		ORTHOPHOSPHATE AS P		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		10		NA		NA		250		NA		NA	
Region 6 PRG (mg/L)			**NA**		**2.19**		**10**		**NA**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
B Aquifer Cont.																		
1-MW-17-GU-P-02	5/1/06	4	29	J	7.8	J			0.094				14		210		0.22	
1-MW-17-GU-P-02	9/8/06	5	24		9.1				0.054				15		200		0.25	
1-MW-17-GU-P-02	2/7/07	6	27		8.7				0.091				20		240		0.29	
AVERAGE			**29.63**		**5.95**		**0.20**		**0.15**		**0.20**		**18.88**		**225.00**		**0.22**	
2-MW-01-GU-P-02	10/11/04	NA	270	J	0.35	J	0.4	U			0.4	U	27	J	470	J		
2-MW-01-GU-P-02	7/13/05	1	250	J	0.89				0.1	U			22		420	J	0.091	J
2-MW-01-GU-P-03	7/16/05	1	250	J	0.9	J			0.05	U			25		420	J	0.096	J
2-MW-01-GU-P-02	10/4/05	2	260	J	0.97				0.01	U			20		440		0.12	
2-MW-01-GU-P-02	1/26/06	3	210	J	0.97				0.11				18		370		0.11	J
2-MW-01-GU-P-02	9/14/06	5	350		0.81				0.24				36		340		0.18	
2-MW-01-GU-P-02	2/14/07	6	400		0.64				0.027				37		350		0.14	
AVERAGE			**284.29**		**0.79**		**N/A**		**0.09**		**N/A**		**26.43**		**401.43**		**0.12**	
2-MW-03-GU-P-02	10/12/04	NA	410	J	0.53	J	1	U			1	U	140	J	360			
2-MW-03-GU-P-02	7/17/05	1	160	J	1	J			0.2	U			9.1		400	J	0.061	J
2-MW-03-GU-P-03	7/18/05	1	170	J	1.2	J			0.2	U			20		440	J	0.096	J
2-MW-03-GU-P-02	10/4/05	2	190	J	1				0.05	U			25		430		0.059	
2-MW-03-GU-P-02	1/24/06	3	160	J	0.75				0.07				7		370		0.077	J
2-MW-03-GU-P-02	9/12/06	5	290		0.81				0.095				5.1		300		0.05	U
2-MW-03-GU-P-02	2/14/07	6	320		0.39				0.01	U			9.2		270		0.05	U
AVERAGE			**242.86**		**0.81**		**N/A**		**0.10**		**N/A**		**30.77**		**367.14**		**0.07**	
1-MW-04-GU-P-09	10/6/04	NA	130	J	1	J	0.4	U			0.4	U	2	U	580	J		
2-MW-04-GU-P-02	7/26/05	1	200	J	2.1				0.5	U			8.6		650		0.25	J
2-MW-04-GU-P-02	10/5/05	2	920	J	2.5				0.05	U			26		600		0.45	
2-MW-04-GU-P-02	1/23/06	3	610	J	2.2				0.023				19		510		0.38	J
2-MW-04-GU-P-02	5/3/06	4	510	J	3	J			0.056				2.8		570		0.39	J
2-MW-04-GU-P-02	9/12/06	5	400		2.6				0.04				2	U	660		0.37	
2-MW-04-GU-P-02	2/8/07	6	330		2.2				0.12				2.1		530		0.66	
AVERAGE			**442.86**		**2.23**				**0.13**				**8.93**		**585.71**		**0.42**	
2-MW-05-GU-P-02	10/18/04	NA	290	J	1.9		0.4	U			0.4	U	18		550	J		
2-MW-05-GU-P-02	7/20/05	1	240	J	2.3				0.1	U			9.9		550	J	0.72	J
2-MW-05-GU-P-02	10/5/05	2	210	J	3.2				0.05	U			2	U	590		0.69	
2-MW-05-GU-P-02	9/12/06	5	190		3.5				0.02				2.6		600		0.81	
2-MW-05-GU-P-02	2/14/07	6	170		2.9				0.01	U			11		430		0.22	
AVERAGE			**220**		**2.76**		**0.4**		**0.045**		**N/A**		**8.7**		**544**		**0.61**	

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE	FLUORIDE	NITRATE AS N	NITRATE/NITRITE AS N	ORTHOPHOSPHATE AS P	SULFATE (SO4)	TOTAL ALKALINITY As CaCO3	TOTAL PHOSPHORUS
NJDEP WQC (mg/L)			250	NA	10	NA	NA	250	NA	NA
Region 6 PRG (mg/L)			**NA**	**2.19**	**10**	**NA**	**NA**	**NA**	**NA**	**0.00073**
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**	**Result (mg/L) Flag**
B Aquifer Cont.										
2-MW-16-GU-P-02	10/12/04	NA	79 J	1.2 J	1 U		7.8 J	120 J	820	
2-MW-16-GU-P-02	8/11/05	1	58 J	1.1 J		0.2 U		83 J	670	5.8 J
2-MW-16-GU-P-02	10/10/05	2	65	1.5		0.011		74	760	6.7
2-MW-16-GU-P-02	1/20/06	3	46 J	0.96		0.057		48	570	3.8 J
2-MW-16-GU-P-02	5/1/06	4	48 J	0.71 J		0.27		77	690	5.4
2-MW-16-GU-P-02	9/8/06	5	53	1		0.046		95	770	3.8
2-MW-16-GU-P-02	2/8/07	6	49	0.57		0.27		72	510	3.5
AVERAGE			**56.86**	**1.01**	**N/A**	**0.14**	**N/A**	**81.29**	**684.29**	**4.83**
2-MW-23-GU-P-02	8/9/05	1	130 J	0.74 J		0.01 U		1 U	310	0.064 J
2-MW-23-GU-P-02	10/12/05	2	120 J	0.89		0.01 U		1 U	310	0.083
2-MW-23-GU-P-02	1/20/06	3	140 J	0.63		0.064		1 U	290	0.15 J
2-MW-23-GU-P-02	5/3/06	4	94 J	0.73 J		0.11		1 U	290	0.11 J
2-MW-23-GU-P-02	9/11/06	5	120	0.72		0.032		1 U	320	0.059
2-MW-23-GU-P-02	2/8/07	6	140	0.67		0.027		1 U	240	0.11
AVERAGE			**124.00**	**0.73**	**N/A**	**0.04**	**N/A**	**1.00**	**293.33**	**0.10**
3-MW-13-GU-P-02	10/14/04	NA	240 J	7	1 U		1 R	1300 J	60 J	
3-MW-13-GU-P-02	8/11/05	1	260 J	12		2 U		1200 J	61 J	0.11 J
3-MW-13-GU-P-02	10/13/05	2	330 J	12		0.01 U		1200	58	0.06
3-MW-13-GU-P-02	1/24/06	3	350 J	13		0.037		970	63	0.073 J
3-MW-13-GU-P-02	5/2/06	4	430 J	13 J		0.098		960	61	0.081
3-MW-13-GU-P-02	9/12/06	5	320	15		0.035		730	64	0.17
3-MW-13-GU-P-02	2/9/07	6	500	13		0.01 U		1200	52	0.097
AVERAGE			**347.14**	**12.14**	**N/A**	**0.37**	**N/A**	**1080.00**	**59.86**	**0.10**
3-MW-14-GU-P-02	10/14/04	NA	940 J	1.3	1 U		1 R	490 J	170 J	
3-MW-14-GU-P-02	8/11/05	1	440 J	3.7		0.01 U		280 J	440 J	0.077 J
3-MW-14-GU-P-02	10/13/05	2	490 J	3.6		0.031		350	430	0.05 U
3-MW-14-GU-P-02	5/2/06	4	470 J	3.7 J		0.05		280	430	0.05 U
3-MW-14-GU-P-02	9/13/06	5	480	3.9		0.015		290	430	0.05 U
3-MW-14-GU-P-02	2/9/07	6	500	3.5		0.01 U		300	420	0.06
AVERAGE			**553.33**	**3.28**	**N/A**	**0.02**	**N/A**	**331.67**	**386.67**	**0.06**
B AQUIFER AVERAGE			**187.34**	**2.84**	**0.47**	**0.11**	**0.96**	**134.73**	**350.11**	**0.56**

Table 4-23
Major Ions in Groundwater, Operable Units 1 and 2
(cont.)

Analyte			CHLORIDE		FLUORIDE		NITRATE AS N		NITRATE/NITRITE AS N		ORTHOPHOSPHATE AS P		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		10		NA		NA		250		NA		NA	
Region 6 PRG (mg/L)			**NA**		**2.19**		**10**		**NA**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
C Aquifer																		
2-MW-25-GU-P-02	11/18/05	2	1200	J	0.5	U			0.04				190		50		0.05	R
2-MW-25-GU-P-02	1/24/06	3	1300	J	0.5	U			0.082				120		240		0.05	U
2-MW-25-GU-P-02	5/3/06	4	1400	J	0.5	UJ			0.016				100		140		0.05	U
2-MW-25-GU-P-02	9/11/06	5	1300		0.5	U			0.052				100		63		0.05	U
2-MW-25-GU-P-02	2/8/07	6	1500		0.5	U			0.01	U			140		70		0.085	
AVERAGE			**1340**		**0.5**		**N/A**		**0.04**		**N/A**		**130**		**112.6**		**0.057**	

Notes:

$CaCO_3$ = Calcium carbonate
mg/L = milligrams per liter
N = Nitrogen
NA = Not Applicable
PRG = Preliminary Remediation Goal
Qual = Qualifier
Qtr = Quarter
NJDEP WQC = New Jersey Department of Environmental Protection Water Quality Criteria
J = Result is an estimated value
R=Nuclide has exceeded 8 half lives
U = Analyte was analyzed for but not detected

Table 4-24
Comparison of Filtered and Unfiltered Uranium in Groundwater, Operable Units 1 and 2

	Quarter 1 (August 2005)		Quarter 2 (October 2005)		Quarter 3 (June 2006)	
Correlation Coefficient	**0.989**		**0.997**		**0.998**	
Well ID	**filtered**	**unfiltered**	**filtered**	**unfiltered**	**filtered**	**unfiltered**
1-MW-06	2.11	1.36	0.81	1.43	0.86	0.6
1-MW-07	0.042	0.01	0.079	0.2	0.12	0.117
1-MW-08	1420	660	41200	37600	30000	30000
1-MW-09	0.77	0.75	0.34	0.45	0.67	0.72
1-MW-10	11.5	25.6	105	95		
1-MW-11	0.17	0.11			0.1	0.15
1-MW-17	446	2.22	4.49	0.26	0.23	0.4
1-MW-18	432	910	660	548	700	790
1-MW-21	1.1	1.01	0.83	0.89	0.45	0.6
1-MW-22	4	5.9	1.39	1.19	1.96	1.92
2-MW-01	30.3	38.1	11.7	11	13.7	12.9
2-MW-02	27100	19800	4290	7000	990	2730
2-MW-03	15200	15000	2300	2190	56100	49900
2-MW-04	2.58	3.29	9.4	11.6	22.4	23.9
2-MW-05	18.7	28.8	3.39	6.1	17.7	12.5
2-MW-11			0.08	0.17		
2-MW-12	9.6	14.4	44.6	29.2	122	244
2-MW-15	730	505	224	190	111	348
2-MW-16	0.57	0.63	4.2	4.1	0.3	0.56
2-MW-19	4.36	3.81	331	0.75	0.78	0.59
2-MW-20	10.6	8.6	5.4	3.61	4.9	3.2
2-MW-23	0.48	0.35	0.33	0.39	0.07	0.12
2-MW-24	0.2	0.05	0.22	0.49	0.23	0.28
2-MW-25			0.68	2.2	0.26	0.35
2-MW-26	0.45	0.25	0.89	1.03	2.77	3.1
3-MW-13	0.41	0.24	0.4	0.24	0.6	0.19
3-MW-14	1.44	2.09	1.53	1.8	6.3	7.6
6-MW-01					452	509
6-MW-02					0.86	0.51
6-MW-03					1.19	1.57
I17-M01A			89	128	122	134

Notes:

Well I17-M01A is in OU3-AOC4

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2

Analyte		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
A Aquifer										
1-MW-06-GU-P-06	10/4/04	1.97 J	0.45	0.125 UJ	0.095	1.38 J	0.35	2.82 J	4.23	0.72
1-MW-06-GU-P-02	8/2/05	0.84 J	0.23	0.027 U	0.042	0.66 J	0.2	1.36 J	2.04	0.4
1-MW-06-GU-P-02	10/6/05	0.46	0.17	0.015 U	0.053	0.7	0.22	1.43	2.14	0.45
1-MW-06-GU-P-02	1/19/06	0.35 U	0.15	0.066	0.067	0.3	0.14	0.6	0.9	0.29
1-MW-06-GU-P-02	4/27/06	0.31 UJ	0.12	0.034 U	0.061	0.28 J	0.12	0.57 J	0.85	0.26
1-MW-06-GU-P-02	9/7/06	0.26	0.13	0.015 U	0.056	0.128 LT	0.086	0.26 LT	0.39	0.18
1-MW-06-GU-P-02	2/8/07	2.08	0.48	0.15 LT	0.1	1.68	0.41	3.43	5.14	0.85
	AVERAGE	**0.90**		**0.06**		**0.73**			**2.24**	
1-MW-08-GU-P-02	10/11/04	6.1 J	1	0.28 J	0.1	5.84 J	0.99	11.9 J	17.8	2
1-MW-08-GU-P-02	8/10/05	334	56	17.9	5.1	322	54	660	**990**	110
1-MW-08-GU-P-02	10/10/05	18500	3400	1010	260	18400	3300	37600	**56372**	6800
1-MW-08-GU-P-02	1/18/06	14400	2200	790	150	14700	2300	30000	**44978**	4600
1-MW-08-GU-P-02	4/28/06	5900 J	1100	383 J	74	6200 J	1100	12600 J	**18891**	2200
1-MW-08-GU-P-02	9/11/06	12700 M3	2000	710 M3	150	13100 M3	2000	26800 M3	**40180**	4200
1-MW-08-GU-P-02	2/13/07	7200 M3	1300	380 M3	100	7400 M3	1300	15200 M3	**22789**	2700
	AVERAGE	**8434.30**		**470.17**		**8589.69**			**26316.53**	
1-MW-10-GU-P-02	10/21/04	37.1 J	6	2.08 J	0.51	38 J	6.2	78 J	**117**	13
1-MW-10-GU-P-02	8/16/05	12.2 J	2	0.51 J	0.16	12.5 J	2.1	25.6 J	**38.4**	4.2
1-MW-10-GU-P-02	10/10/05	48	8	2.44	0.63	46.5	7.8	95	**142**	16
1-MW-10-GU-P-02	1/17/06									
1-MW-10-GU-P-02	4/28/06	64.6 J	10	6.4 J	1.1	67 J	11	137 J	**205**	22
1-MW-10-GU-P-02	9/7/06	8.5	1.6	0.42	0.19	8.8	1.6	18	27.0	3.4
1-MW-10-GU-P-02	2/12/07	39.8	6.9	2.29	0.57	40.8	7.1	83	**124**	15
	AVERAGE	**35.03**		**2.36**		**35.60**			**109.10**	
1-MW-18-GU-P-06	10/5/04	479 J	81	31.3 J	6.1	468 J	79	960 J	**1439**	160
1-MW-18-GU-P-02	8/10/05	420	69	19.9	5.1	443	73	910	**1364**	150
2-MW-18-GU-P-02	10/6/05	269	43	15.5	3.4	268	43	548	**822**	87
1-MW-18-GU-P-02	1/18/06	374	58	21.8	4.3	384	59	790	**1184**	120
1-MW-18-GU-P-02	5/1/06	143	28	6.3	1.6	144	28	295	**442**	57
1-MW-18-GU-P-02	9/7/06	466 M3	78	22.1 M3	4.1	470 M3	78	960 M3	**1439**	160
1-MW-18-GU-P-02	2/7/07	328 M3	62	11.2 M3	5	308 M3	58	630 M3	**945**	120
	AVERAGE	**354.14**		**18.30**		**355.00**			**1090.81**	

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

	Analyte	U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
A Aquifer Cont.										
1-MW-21-GU-P-02	8/10/05	1.2	0.31	0.027 U	0.048	0.49	0.17	1.01	1.51	0.35
1-MW-21-GU-P-02	10/7/05	1.3 J	0.32	0.01 U	0.05	0.43 J	0.16	0.89 J	1.33	0.32
1-MW-21-GU-P-02	1/19/06	0.63	0.21	-0.003 U	0.054	0.29	0.13	0.6	0.90	0.27
1-MW-21-GU-P-02	5/1/06	0.59	0.22	-0.006 U	0.07	0.18	0.11	0.36	0.54	0.23
1-MW-21-GU-P-02	9/7/06	0.124 LT	0.09	0.027 U	0.058	0.06 U	0.063	0.12 U	0.18	0.13
1-MW-21-GU-P-02	2/7/07	0.28	0.14	0.03 U	0.055	0.2 LT	0.11	0.4 LT	0.60	0.22
	AVERAGE	**0.69**		**0.01**		**0.28**			**0.84**	
1-MW-22-GU-P-02	8/11/05	7.5 J	1.5	0.16 J	0.13	2.89 J	0.69	5.9 J	8.85	1.4
1-MW-22-GU-P-02	10/7/05	1.48 J	0.35	0.057 J	0.057	0.58 J	0.19	1.19 J	1.78	0.4
is CF is consistent with th	1/19/06	2.04	0.46	0.016 U	0.057	0.94	0.27	1.92	2.88	0.55
1-MW-22-GU-P-02	4/28/06	1.42 J	0.31	0.044 J	0.04	0.59 J	0.17	1.21 J	1.81	0.34
1-MW-22-GU-P-02	9/8/06	0.63	0.21	-0.008 U	0.055	0.55	0.2	1.13	1.69	0.41
1-MW-22-GU-P-02	2/7/07	1.66	0.4	0.029 U	0.053	1.11	0.3	2.27	3.40	0.61
	AVERAGE	**2.46**		**0.05**		**1.11**			**3.40**	
2-MW-02-GU-P-02	10/25/04	11500	2000	540	110	11600	2000	23700	**35532**	4000
2-MW-02-GU-P-02	8/3/05	9200	1500	550	150	9700	1600	19800	**29685**	3300
2-MW-02-GU-P-02	10/14/05	3500	550	189	40	3400	540	7000	**10495**	1100
2-MW-02-GU-P-02	1/24/06	1290	210	81	18	1330	220	2730	**4093**	440
2-MW-02-GU-P-02	5/4/06	1810 J	300	110 J	29	1830 J	310	3750 J	**5622**	630
2-MW-02-GU-P-02	9/11/06	670 M3	110	34.6 M3	6.8	690 M3	120	1410 M3	**2114**	240
2-MW-02-GU-P-02	2/13/07	3140 M3	550	224 M3	56	3460 M3	600	7100 M3	**10645**	1200
	AVERAGE	**4444.29**		**246.94**		**4572.86**			**14026.56**	
2-MW-12-GU-P-06	10/6/04	34.2 J	5.5	2.2 J	0.5	35.3 J	5.7	72 J	**108**	12
2-MW-12-GU-P-02	8/3/05	6.1	1.1	0.3	0.13	7	1.3	14.4	22	2.6
2-MW-12-GU-P-02	10/11/05	14.5 J	2.5	0.77 J	0.29	14.3 J	2.5	29.2 J	**44**	5.1
2-MW-12-GU-P-02	1/23/06	123 J	21	6.2 J	1.4	119 J	20	244 J	**366**	42
2-MW-12-GU-P-02	5/3/06	30.6 J	5.1	1.52 J	0.38	30.3 J	5.1	62 J	**93**	10
2-MW-12-GU-P-02	9/8/06	11.9	2.1	0.62	0.22	12.7	2.2	25.9	**39**	4.5
2-MW-12-GU-P-02	2/8/07	152	27	7.7	1.6	154	28	315	**472**	57
	AVERAGE	**53.19**		**2.76**		**53.23**			**163.31**	

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

	Analyte	U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
A Aquifer Cont.										
2-MW-15-GU-P-02	10/15/04	16.3 J	2.6	0.76 J	0.19	15.8 J	2.5	32.3 J	**48**	5.2
2-MW-15-GU-P-02	8/10/05	248	41	12.4	3.2	247	41	505	**757**	84
2-MW-15-GU-P-02	10/14/05	94 J	17	4.4 J	1.1	93 J	16	190 J	**285**	34
2-MW-15-GU-P-02	1/25/06	169	25	11.7	2	170	26	348	**522**	52
2-MW-15-GU-P-02	5/9/06	84 J	15	4.4 J	1	87 J	16	177 J	**265**	32
2-MW-15-GU-P-02	9/13/06	34.4	5.7	2.22	0.46	36	6	74	**111**	12
	AVERAGE	**107.62**		**5.98**		**108.13**			**331.41**	
2-MW-19-GU-P-02	8/25/05	2.02 J	0.45	0.24 J	0.12	1.86 J	0.43	3.81 J	5.71	0.87
2-MW-19-GU-P-02	10/14/05	0.32	0.14	0.049 U	0.066	0.37	0.15	0.75	1.12	0.3
2-MW-19-GU-P-02	1/24/06	0.39	0.17	0.009 U	0.061	0.29	0.14	0.59	0.88	0.3
2-MW-19-GU-P-02	5/4/06	0.13 U	0.11	0.058 U	0.07	0.22 UJ	0.13	0.45 J	0.67	0.27
2-MW-19-GU-P-02	9/13/06	0.62	0.18	0.018 U	0.039	0.59	0.17	1.22	1.83	0.35
2-MW-19-GU-P-02	2/14/07	0.42	0.15	U	0.046	0.43	0.16	0.89	1.33	0.32
	AVERAGE	**0.65**		**0.07**		**0.63**			**1.93**	
2-MW-20-GU-P-02	8/9/05	4.57 J	0.88	0.124 UJ	0.078	4.22 J	0.82	8.6 J	12.9	1.7
2-MW-20-GU-P-02	10/13/05	1.92	0.42	0.115	0.085	1.77	0.4	3.61	5.41	0.81
2-MW-20-GU-P-02	1/23/06	1.82 J	0.41	0.07 J	0.064	1.56 J	0.37	3.2 J	4.80	0.75
2-MW-20-GU-P-02	5/3/06	1.83 UJ	0.47	0.11 U	0.1	1.43 UJ	0.39	2.92 UJ	4.38	0.81
2-MW-20-GU-P-02	9/12/06	0.43	0.18	0.006 U	0.052	0.46	0.17	0.94	1.41	0.35
2-MW-20-GU-P-02	2/9/07	0.215	0.073	0.024 U	0.027	0.216	0.073	0.44	0.66	0.15
	AVERAGE	**1.80**		**0.07**		**1.61**			**4.93**	
2-MW-24-GU-P-02	8/10/05	0.072	0.057	0.01 U	0.041	0.024 U	0.035	0.05 U	0.07	0.071
2-MW-24-GU-P-02	10/10/05	0.23	0.14	0.084 U	0.089	0.24	0.14	0.49	0.73	0.29
2-MW-24-GU-P-02	1/20/06	0.046 U	0.067	0.068 U	0.077	0.136	0.097	0.28	0.42	0.2
2-MW-24-GU-P-02	5/1/06	0.093 U	0.081	0.012 U	0.055	0.089 U	0.081	0.18 U	0.27	0.17
2-MW-24-GU-P-02	9/8/06	0.046 U	0.062	U	0.05	0.076 LT	0.065	0.16 LT	0.24	0.13
2-MW-24-GU-P-02	2/8/07	0.048 U	0.059	0.045 LT	0.054	0.148 LT	0.091	0.3 LT	0.45	0.19
	AVERAGE	**0.09**		**0.04**		**0.12**			**0.36**	
2-MW-26-GU-P-02	8/9/05	0.186 J	0.091	0.011 U	0.042	0.121 J	0.075	0.25 J	0.37	0.15
2-MW-26-GU-P-02	10/12/05	0.71 J	0.28	0.09 U	0.11	0.5 J	0.23	1.03 J	1.54	0.47
2-MW-26-GU-P-02	1/24/06	1.9	0.49	0.19	0.14	1.52	0.41	3.1	4.65	0.85

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
A Aquifer Cont.										
2-MW-26-GU-P-02	5/1/06	0.66	0.21	0.024 U	0.051	0.55	0.19	1.13	1.69	0.39
2-MW-26-GU-P-02	9/11/06	0.71	0.23	0.016 U	0.058	0.64	0.22	1.31	1.96	0.44
2-MW-26-GU-P-02	2/8/07	0.52	0.19	0.051 U	0.062	0.54	0.19	1.11	1.66	0.4
AVERAGE		**0.78**		**0.06**		**0.65**			**1.98**	
A AQUIFER AVERAGES		**1131.35**		**64.44**		**1155.29**		**2361.98**		
B Aquifer										
1-MW-04-GU-P-06	10/6/04	0.62 UJ	0.2	0.044 U	0.059	0.47 J	0.17	0.96 J	1.44	0.34
AVERAGE		**N/A**		**N/A**		**N/A**		**N/A**		
1-MW-07-GU-P-09	10/4/04	0.23 UJ	0.12	0.054 U	0.065	0.117 J	0.083	0.24 J	0.36	0.17
1-MW-07-GU-P-02	8/2/05	0.094 J	0.067	0.024 U	0.042	0.005 U	0.036	0.01 U	0.01	0.073
1-MW-07-GU-P-02	10/6/05	0.11	0.11	-0.01 U	0.11	0.1 U	0.11	0.2 U	0.30	0.22
1-MW-07-GU-P-02	1/18/06	0.065 U	0.051	0.009 U	0.034	0.057	0.045	0.117	0.18	0.091
1-MW-07-GU-P-02	4/28/06	0.07 U	0.073	-0.002 U	0.041	0.072 U	0.059	0.15 U	0.22	0.12
1-MW-07-GU-P-02	9/7/06	0.075 U	0.085	0.03 U	0.062	0.003 U	0.051	0.01 U	0.01	0.11
1-MW-07-GU-P-02	2/6/07	0.115 LT	0.081	0.02 U	0.052	0.033 U	0.045	0.068 U	0.10	0.091
AVERAGE		**0.11**		**0.02**		**0.06**			**0.17**	
1-MW-09-GU-P-09	10/5/04	3.75 J	0.73	0.21 UJ	0.12	3.65 J	0.72	7.5 J	11.24	1.5
1-MW-09-GU-P-02	8/3/05	0.47	0.16	0.008 U	0.044	0.36	0.14	0.75	1.12	0.28
1-MW-09-GU-P-02	10/5/05	0.168 J	0.099	0.01 U	0.052	0.22 J	0.11	0.45 J	0.67	0.22
1-MW-09-GU-P-02	1/17/06	0.34 U	0.13	0.039 U	0.046	0.35	0.13	0.72	1.08	0.26
1-MW-09-GU-P-02	4/27/06	0.141 UJ	0.074	0.029 J	0.041	0.092 UJ	0.059	0.19 UJ	0.28	0.12
1-MW-09-GU-P-02	9/7/06	0.14 LT	0.11	0.027 U	0.068	0.089 U	0.099	0.18 U	0.27	0.2
1-MW-09-GU-P-02	2/6/07	0.28	0.13	0.04 U	0.054	0.29	0.13	0.59	0.88	0.27
1-MW-09-GU-P-12	6/26/07	0.144 LT	0.089	0.015 U	0.051	0.074 LT	0.062	0.15 LT	0.22	0.13
AVERAGE		**0.68**		**0.05**		**0.64**			**1.97**	
1-MW-11-GU-P-02	10/13/04	0.156 U	0.092	0.035 U	0.053	0.132	0.084	0.27	0.40	0.17
1-MW-11-GU-P-02	8/9/05	0.055 U	0.049	0.011 U	0.036	0.053 U	0.053	0.11 U	0.16	0.11
2-MW-11-GU-D-02	10/6/05	0.05 U	0.056	U	0.052	0.083 U	0.072	0.17 U	0.25	0.15

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
B Aquifer Cont.										
1-MW-11-GU-P-02	1/17/06	0.065 U	0.051	0.036	0.036	0.072	0.05	0.15	0.22	0.1
1-MW-11-GU-P-02	4/27/06	0.148 UJ	0.073	0.048 U	0.047	0.078 U	0.061	0.16 U	0.24	0.12
1-MW-11-GU-P-02	9/7/06	0.08 U	0.076	U	0.059	0.047 U	0.057	0.1 U	0.15	0.12
1-MW-11-GU-P-02	2/7/07	0.012 U	0.052	0.043 U	0.058	0.032 U	0.049	0.07 U	0.10	0.1
	AVERAGE	**0.08**		**0.03**		**0.07**			**0.22**	
1-MW-17-GU-P-09	10/5/04	2.47 J	0.52	0.128 UJ	0.091	2.25 J	0.49	4.61 J	6.91	0.99
1-MW-17-GU-P-02	8/10/05	1.12	0.28	0.071	0.063	1.09	0.28	2.22	3.33	0.57
1-MW-17-GU-P-02	10/7/05	0.1 J	0.077	0.023 U	0.05	0.126 J	0.081	0.26 J	0.39	0.16
1-MW-17-GU-P-02	1/18/06	0.207 U	0.087	0.005 U	0.035	0.195	0.083	0.4	0.60	0.17
1-MW-17-GU-P-02	5/1/06	0.27	0.12	0.019 U	0.048	0.18	0.095	0.37	0.55	0.19
1-MW-17-GU-P-02	9/8/06	0.21	0.11	0.009 U	0.049	0.119 LT	0.079	0.24 LT	0.36	0.16
1-MW-17-GU-P-02	2/7/07	0.55	0.2	0.006 U	0.059	0.63	0.22	1.28	1.92	0.44
	AVERAGE	**0.70**		**0.04**		**0.66**			**2.01**	
2-MW-01-GU-P-02	10/11/04	2.27 J	0.43	0.096 J	0.057	2.28 J	0.43	4.66 J	7.0	0.87
2-MW-01-GU-P-02	7/13/05	18.1 J	2.9	0.93 J	0.24	18.6 J	3	38.1 J	**57.1**	6.2
2-MW-01-GU-P-02	10/4/05	5.33 J	0.95	0.25 J	0.12	5.4 J	0.97	11 J	16.5	2
2-MW-01-GU-P-02	1/26/06	6.5	1.2	0.67	0.25	6.3	1.2	12.9	19.3	2.4
2-MW-01-GU-P-02	5/4/06	5.8 J	1.1	0.39 J	0.18	5.8 J	1.1	11.9 J	17.8	2.3
2-MW-01-GU-P-02	9/14/06	5.2	1	0.29	0.13	5.2	1	10.7	16.0	2.1
2-MW-01-GU-P-02	2/14/07	0.45	0.19	0.038 U	0.068	0.55	0.21	1.13	1.7	0.43
2-MW-01-GU-P-03	7/16/05	10.8 J	1.8	0.48 J	0.13	10.4 J	1.7	21.2 J	**31.8**	3.5
	AVERAGE	**6.81**		**0.39**		**6.82**			**20.91**	
2-MW-03-GU-P-02	10/12/04	4290	680	175	41	4440	700	9100	**13643**	1400
2-MW-03-GU-P-02	7/17/05	7400 J	1300	385 J	80	7300 J	1300	15000 J	**22489**	2600
2-MW-03-GU-P-02	10/4/05	1160	190	63	22	1070	180	2190	**3283**	370
2-MW-03-GU-P-02	1/24/06	23600	3900	1940	420	24400	4000	49900	**74813**	8100
2-MW-03-GU-P-02	5/4/06	14300 J	3300	820 J	630	16300 J	3700	33400 J	**50074.963**	7500
2-MW-03-GU-P-02	9/12/06	6400 M3	1100	278 M3	67	6600 M3	1100	13400 M3	**20089.955**	2300
2-MW-03-GU-P-02	2/14/07	13900 M3	2600	700 M3	190	14500 M3	2700	29800 M3	**44678**	5600
2-MW-03-GU-P-03	7/18/05	2370	400	109	22	2420	400	4940	**7406**	820
	AVERAGE	**9177.50**		**558.75**		**9628.75**			**29559.60**	

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
B Aquifer Cont.										
2-MW-04-GU-P-02	7/26/05	1.44 J	0.35	0.16 J	0.1	1.61 J	0.38	3.29 J	4.93	0.77
2-MW-04-GU-P-02	10/5/05	6.1 J	1.1	0.25 J	0.13	5.7 J	1	11.6 J	17.4	2.1
2-MW-04-GU-P-02	1/23/06	11.3 J	1.9	0.46 J	0.18	11.7 J	2	23.9 J	**35.8**	4
2-MW-04-GU-P-02	5/3/06	2.11 UJ	0.5	0.114 J	0.093	2.29 UJ	0.53	4.7 UJ	7.05	1.1
2-MW-04-GU-P-02	9/12/06	0.57	0.19	0.025 U	0.052	0.67	0.22	1.36	2.04	0.44
2-MW-04-GU-P-02	2/8/07	0.62	0.21	0.047 LT	0.057	0.56	0.2	1.14	1.71	0.4
2-MW-04-GU-P-17	6/27/07	0.5	0.17	0.054 LT	0.055	0.58	0.19	1.19	1.78	0.39
AVERAGE		**3.23**		**0.16**		**3.30**			**10.10**	
2-MW-05-GU-P-02	10/18/04	15.8	2.9	0.7	0.31	14.9	2.7	30.4	**45.6**	5.6
2-MW-05-GU-P-02	7/20/05	13.4 J	2.2	0.94 J	0.25	14.1 J	2.3	28.8 J	**43.2**	4.7
2-MW-05-GU-P-02	10/5/05	2.79 J	0.57	0.18 J	0.11	2.98 J	0.6	6.1 J	9.1	1.2
2-MW-05-GU-P-02	1/25/06	6.5	1	0.39	0.1	6.09	0.96	12.5	18.7	2
2-MW-05-GU-P-02	5/4/06	9.2 J	1.7	0.47 J	0.19	9 J	1.6	18.5 J	27.7	3.3
2-MW-05-GU-P-02	9/12/06	2.27	0.5	0.129 LT	0.089	2.4	0.52	4.9	7.3	1.1
2-MW-05-GU-P-02	2/14/07	337 M3	64	17.9 M3	4.8	332 M3	63	680 M3	**1019**	130
AVERAGE		**55.28**		**2.96**		**54.50**			**167.32**	
2-MW-16-GU-P-02	10/12/04	4.4 J	0.78	0.29 J	0.11	4.28 J	0.76	8.8 J	13.19	1.6
2-MW-16-GU-P-02	8/11/05	0.35 J	0.17	0.033 U	0.072	0.31 J	0.16	0.63 J	0.94	0.33
2-MW-16-GU-P-02	10/10/05	2.34	0.63	0.15	0.14	1.99	0.57	4.1	6.15	1.2
2-MW-16-GU-P-02	1/20/06	0.081 U	0.086	0.056 U	0.083	0.27	0.15	0.56	0.84	0.3
2-MW-16-GU-P-02	5/1/06	0.27	0.13	0.025 U	0.053	0.2	0.11	0.42	0.63	0.23
2-MW-16-GU-P-02	9/8/06	0.45	0.17	-0.003 U	0.051	0.33	0.14	0.67	1.00	0.29
2-MW-16-GU-P-02	2/8/07	0.16 LT	0.097	0.062 U	0.071	0.116 LT	0.08	0.24 LT	0.36	0.16
AVERAGE		**1.15**		**0.09**		**1.07**			**3.30**	
2-MW-23-GU-P-02	8/9/05	0.23 J	0.11	-0.02 U	0.038	0.173 J	0.09	0.35 J	0.52	0.18
2-MW-23-GU-P-02	10/12/05	0.107 U	0.098	U	0.081	0.19 J	0.13	0.39 J	0.58	0.26
2-MW-23-GU-P-02	1/20/06	0.18 U	0.11	0.033 U	0.06	0.056	0.057	0.12	0.18	0.12
2-MW-23-GU-P-02	5/3/06	0.086 U	0.086	-0.017 U	0.066	0.05 U	0.074	0.1 U	0.15	0.15
2-MW-23-GU-P-02	9/11/06	0.19 LT	0.11	-0.012 U	0.047	0.175 LT	0.096	0.36 LT	0.54	0.2
2-MW-23-GU-P-02	2/8/07	0.62	0.21	0.061 U	0.067	0.57	0.2	1.17	1.75	0.42
AVERAGE		**0.24**		**0.01**		**0.20**			**0.62**	

Table 4-25
Isotopic and Total Uranium in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	Result (ug/L)	TPU [+/- 2σ]
B Aquifer Cont.										
3-MW-13-GU-P-02	10/14/04	0.206 UJ	0.087	0.024 U	0.033	0.17 J	0.078	0.35 J	0.52	0.16
3-MW-13-GU-P-02	8/11/05	0.15 U	0.13	-0.03 U	0.085	0.12 U	0.11	0.24 U	0.36	0.23
3-MW-13-GU-P-02	10/13/05	0.52	0.2	0.048 U	0.068	0.117	0.089	0.24	0.36	0.18
3-MW-13-GU-P-02	1/24/06	0.25	0.17	0.11 U	0.11	0.09 U	0.11	0.19 U	0.28	0.22
3-MW-13-GU-P-02	9/12/06	0.094 U	0.086	0.022 U	0.058	0.132 LT	0.089	0.27 LT	0.40	0.18
3-MW-13-GU-P-02	2/9/07	0.235	0.092	0.049 U	0.043	0.148 LT	0.071	0.3 LT	0.45	0.15
	AVERAGE	**0.24**		**0.04**		**0.13**			**0.40**	
3-MW-14-GU-P-02	10/14/04	0.29 UJ	0.11	0.024 U	0.033	0.249 J	0.096	0.51 J	0.76	0.2
3-MW-14-GU-P-02	8/11/05	1.07 J	0.35	0.024 U	0.086	1.02 J	0.34	2.09 J	3.13	0.7
3-MW-14-GU-P-02	10/13/05	1.11	0.29	0.051 U	0.056	0.88	0.24	1.8	2.70	0.5
3-MW-14-GU-P-02	1/25/06	3.79	0.61	0.226	0.073	3.74	0.6	7.6	11.4	1.2
3-MW-14-GU-P-02	9/13/06	0.94	0.24	0.004 U	0.04	0.7	0.2	1.44	2.16	0.4
3-MW-14-GU-P-02	2/9/07	1.29	0.25	0.099 LT	0.049	0.87	0.18	1.78	2.67	0.38
	AVERAGE	**1.42**		**0.07**		**1.24**			**3.80**	
B AQUIFER AVERAGE		**869.60**		**54.84**		**911.97**		**2799.7**		
C Aquifer										
2-MW-25-GU-P-02	11/18/05	0.8	0.27	0.001 U	0.074	1.08	0.33	2.2	3.30	0.67
2-MW-25-GU-P-02	1/24/06	0.16	0.11	0.038 U	0.068	0.17	0.11	0.35	0.52	0.23
2-MW-25-GU-P-02	5/3/06	0.063 U	0.07	-0.001 U	0.05	0.06 U	0.065	0.12 U	0.18	0.13
2-MW-25-GU-P-02	9/11/06	0.44	0.17	0.068 U	0.066	0.31	0.14	0.64	0.96	0.28
2-MW-25-GU-P-02	2/8/07	0.6	0.26	0.04 U	0.1	0.69	0.29	1.41	2.11	0.59
	AVERAGE	**0.41**		**0.03**		**0.46**		**1.42**		

Notes:

TPU=Total Propagated Uncertainty

U=Result is less than the sample specific MDC

J=Result is an estimated value

LT=Result is less than requested MDC but greater than sample specific MDC

M3=The requested MDC was not met, but the reported activity is greater than the reported MDC.

Shading indicate sample result above MCL of 30 ug/L total uranium

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2

	Analyte	GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
	MCL	15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
A Aquifer															
1-MW-06-GU-P-02	10/4/04	2.68 J	0.87	15.9 J	2.8										
1-MW-06-GU-P-04	10/4/04					0.26 J	0.18	0.21 U	0.5						
1-MW-06-GU-P-02	10/6/05	0.83 U	0.69	30	5.1	0.22 J	0.15	1.05 J	0.5						
1-MW-06-GU-P-02	1/19/06	0.31 U	0.49	16.7	2.9	0.15 U	0.19	0.64 U	0.49						
1-MW-06-GU-P-02	4/27/06	0.24 UJ	0.54	20.8	3.7	0.28 J	0.17	0.52 U	0.4	0.018 U	0.039	-0.02 U	0.052	U	0.016
1-MW-06-GU-P-02	9/7/06	0.36 U	0.52	24	4.1	0.32 LT	0.16	0.76 LT	0.43	U	0.087	0.092 U	0.084	0.001 U	0.022
1-MW-06-GU-P-02	2/8/07	4.6	1.3	18.3	3.3	0.63 LT	0.29	0.67 U	0.41	0.114 LT	0.066	-0.008 U	0.061	0.006 U	0.021
1-MW-06-GU-P-02	10/11/04	5.6 J	1.2	35.9 J	5.9	0.055 U	0.055	0.45 U	0.45						
	AVERAGE	**2.09**		**23.09**		**0.27**		**0.61**		**0.07**		**0.02**		**0.00**	
1-MW-08-GU-P-02	8/10/05	**434** J	70	231 J	37	0.15 U	0.13	0.38 U	0.39						
1-MW-08-GU-P-02	10/10/05	**22400**	3600	7700	1200	0.08 U	0.1	0.17 U	0.42						
1-MW-08-GU-P-02	1/18/06	**18500**	3000	8200	1300	0.33 J	0.21	0.51 U	0.36						
1-MW-08-GU-P-02	4/28/06	**6900** J	1100	3730 J	600	0.26 J	0.17	0.57 U	0.39	0.02 U	0.46	0.11 U	0.48	0.06 U	0.17
1-MW-08-GU-P-02	9/11/06	**22700** M3	3600	8800 M3	1400	0.28 U	0.27	2 U,M	2.8	0.033 U	0.071	0.055 U	0.077	0.012 U	0.028
1-MW-08-GU-P-02	2/13/07	**11500**	1800	4670 M3	740	0.2 LT	0.15	0.36 U	0.36	-0.023 U	0.07	-0.015 U	0.063	0.007 U	0.024
	AVERAGE	**13739.00**		**5555.17**		**0.22**		**0.67**		**0.01**		**0.05**		**0.03**	
1-MW-10-GU-P-02	10/21/04	**62** J	10	58.3 J	9.4	0.16 J	0.093	0.52 U	0.46						
1-MW-10-GU-P-02	8/16/05	13.5 J	2.6	50.9	8.3	0.32 J	0.19	0.36 U	0.44						
1-MW-10-GU-P-02	10/10/05	**65**	11	50.2	8.3	0.25 J	0.14	0.34 U	0.44						
1-MW-10-GU-P-02	1/17/06	**106**	18	51.3	8.7	0.35 U	0.34	0.76 U	0.51						
1-MW-10-GU-P-02	4/28/06	**92** J	15	75 J	12	0.13 U	0.21	0.26 U	0.35	0.026 U	0.073	0.161 J	0.087	0.037 U	0.028
1-MW-10-GU-P-02	9/7/06	12.4	2.5	43.9	7.3	0.15 LT	0.1	0.58 U	0.43	0.003 U	0.078	0.152 LT	0.089	0.022 U	0.032
1-MW-10-GU-P-02	2/12/07	**90**	15	135	22	0.026 U	0.071	0.13 U	0.35	0.03 U	0.05	0.049 U	0.065	0.022 LT	0.02
	AVERAGE	**62.99**		**66.37**		**0.20**		**0.42**		**0.02**		**0.12**		**0.03**	
1-MW-18-GU-P-02	10/5/04	**608** J	97	242 J	39										
1-MW-18-GU-P-04	10/5/04					0.13 U	0.14	0.39 U	0.41						
1-MW-18-GU-P-02	8/10/05	**476** J	76	408 J	65	0.41 J	0.22	1.98 J	0.71						
1-MW-18-GU-P-02	1/18/06	**436**	70	270	43	0.11 U	0.11	0.47 U	0.35						
1-MW-18-GU-P-02	5/1/06	**188** J	30	148	24	0.34 J	0.19	0.17 U	0.33	0.006 U	0.083	-0.03 U	0.067	0.008 U	0.017
1-MW-18-GU-P-02	9/7/06	**528**	85	271 M3	44	0.39 LT	0.18	0.39 U	0.45	0.036 U	0.087	0.058 U	0.073	0.019 U	0.022
1-MW-18-GU-P-02	2/7/07	**940**	150	680 M3	110	0.22 LT	0.15	0.79 LT	0.45	0.034 U	0.071	0.02 U	0.067	0.02 U	0.023
2-MW-18-GU-P-02	10/6/05	**283**	46	169	27	0.21 J	0.15	0.47 U	0.41						
	AVERAGE	**494.14**		**312.57**		**0.26**		**0.67**		**0.03**		**0.02**		**0.02**	

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
A Aquifer Cont.															
1-MW-21-GU-P-02	8/10/05	1.85 J	0.62	4.1 J	1.1	0.26 J	0.17	-0.22 U	0.41						
1-MW-21-GU-P-02	10/7/05	1.11 J	0.48	3.48	0.98	0.24 U	0.22	0.32 U	0.34						
1-MW-21-GU-P-02	1/19/06	1.12	0.47	2.94	0.92	0.04 U	0.12	0.75 U	0.51						
1-MW-21-GU-P-02	5/1/06	1.19 UJ	0.83	2.7	1.2	0.17 U	0.13	0.39 U	0.34	0.022 U	0.085	0.042 U	0.071	0.01 U	0.02
1-MW-21-GU-P-02	9/7/06	1.13 U	0.9	3.7 LT	1.6	0.16 LT	0.11	0.6 U	0.44	0.009 U	0.068	0.082 U	0.075	-0.002 U	0.02
is CF is consistent with th	2/7/07	1.43 U	0.98	3.7 LT	1.5	0.1 U	0.12	0.61 U	0.37	0.012 U	0.076	-0.055 U	0.055	0.007 U	0.021
AVERAGE		**1.31**		**3.44**		**0.16**		**0.41**		**0.01**		**0.02**		**0.01**	
1-MW-22-GU-P-02	8/11/05	6.4	2.3	16.3	5.7	0.09 U	0.12	0.17 U	0.38						
1-MW-22-GU-P-02	10/7/05	2.2 UJ	2.1	24.4	5.7	0.41 J	0.28	0.14 U	0.33						
1-MW-22-GU-P-02	1/19/06	1.9	1.2	11.2	2.9	0.32 J	0.25	0.62 U	0.4						
1-MW-22-GU-P-02	4/28/06	3.2 J	1.2	14.7 J	3.1	0.18 J	0.14	0.31 U	0.34	0.058 U	0.079	-0.009 U	0.073	0.086 J	0.046
1-MW-22-GU-P-02	9/8/06	0.36 U	0.83	16.3	3.3	0.2 Y1,LT	0.13	0.34 U	0.43	0.033 U	0.058	0.021 U	0.062	0.012 U	0.025
1-MW-22-GU-P-02	2/7/07	3.9	1.3	9.6	2.2	0.11 U	0.11	0.6 U	0.47	0.035 U	0.078	-0.02 U	0.06	0.014 U	0.024
AVERAGE		**2.99**		**15.42**		**0.22**		**0.36**		**0.04**		**0.00**		**0.04**	
2-MW-02-GU-P-02	10/25/04	**12900** J	2100	3490 J	560	0.59 J	0.22	1.35 J	0.63						
2-MW-02-GU-P-02	8/3/05	**9500** J	1500	2870	460	0.61 J	0.28	1.49	0.57						
2-MW-02-GU-P-02	10/14/05	**3530**	560	1500	240	0.46 J	0.31	2.73 UJ	0.94						
2-MW-02-GU-P-02	1/24/06	**1720** J	270	790	130	0.51 J	0.26	2.95 J	0.99						
2-MW-02-GU-P-02	5/4/06	**1990**	320	1120	180	1 J	0.41	0.98 J	0.47	0.052 U	0.07	-0.013 U	0.056	0.016 U	0.019
2-MW-02-GU-P-02	9/11/06	**790**	130	517 M3	83	0.49 LT	0.13	0.38 U,M	0.61	0.023 U	0.096	-0.01 U	0.1	0.027 U	0.037
2-MW-02-GU-P-02	2/13/07	**3710**	590	1770 M3	280	0.38 LT	0.2	1.03	0.48	-0.04 U	0.076	0.21	0.11	0.001 U	0.029
AVERAGE		**4877.14**		**1722.43**		**0.58**		**1.56**		**0.01**		**0.06**		**0.01**	
2-MW-12-GU-P-02	10/6/04	37.3 J	6.3	23.6 J	4	0.09 U	0.11	0.29 U	0.42						
2-MW-12-GU-P-02	8/3/05	6.2 J	2	20.4	4	0.15 U	0.12	0.62 U	0.43						
2-MW-12-GU-P-02	10/11/05	**16.4**	3.6	33.8	6.2	0.19 J	0.1	0.87 J	0.44						
2-MW-12-GU-P-02	1/23/06	**127**	21	49.9	8.3	0.14 U	0.18	0.33 U	0.35						
2-MW-12-GU-P-02	5/3/06	**46.2**	8.1	35.4	6.1	0.19 J	0.14	0.23 U	0.36	-0.013 U	0.037	-0.007 U	0.05	0.002 U	0.013
2-MW-12-GU-P-02	9/8/06	11.5	2.5	28.9	5	0.09 U	0.093	0.62 U	0.43	0.013 U	0.033	-0.055 U	0.05	0.019 LT	0.019
2-MW-12-GU-P-02	2/8/07	**194**	32	87	14	0.11 U	0.11	0.52 U	0.42	0.01 U	0.055	0.007 U	0.067	0.004 U	0.023
AVERAGE		**62.66**		**39.86**		**0.14**		**0.50**		**0.00**		**-0.02**		**0.01**	
2-MW-15-GU-P-02	10/15/04	**19.6** J	3.6	28.6 J	5	0.036 U	0.071	0.41 U	0.46						
2-MW-15-GU-P-02	8/10/05	**288** J	46	121 J	20	0.7 J	0.3	0.93 J	0.48						
2-MW-15-GU-P-02	10/14/05	**108**	18	88	14	0.67 J	0.39	1.21 UJ	0.51						

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
A Aquifer Cont.															
2-MW-15-GU-P-02	1/25/06	**181**	29	119	19	0.41 J	0.2	0.43 U	0.46						
2-MW-15-GU-P-02	5/9/06	**101**	17	84	14	0.41 J	0.2	1.19 J	0.54	0.021 U	0.027	-0.009 U	0.057	0.008 U	0.017
2-MW-15-GU-P-02	9/13/06	**42**	7.4	59.9	9.9	0.49 LT	0.23	0.79 U	0.53	-0.041 U	0.095	-0.026 U	0.067	-0.004 U	0.032
AVERAGE		**123.27**		**83.42**		**0.45**		**0.83**		**-0.01**		**-0.02**		**0.00**	
2-MW-19-GU-P-02	8/25/05	2.7	1.2	15.6	3.2	0.56 J	0.26	0.81 J	0.4						
2-MW-19-GU-P-02	10/14/05	2.4	0.98	16.5	3.2	0.6 J	0.37	1.18 UJ	0.51						
2-MW-19-GU-P-02	1/24/06	0.91 UJ	0.8	8.8	2.1	0.39 J	0.2	0.38 U	0.36						
2-MW-19-GU-P-02	5/4/06	1.46	0.83	11.7	2.4	0.22 J	0.14	0.4 U	0.35	0.055 U	0.055	0.029 U	0.062	0.013 U	0.021
2-MW-19-GU-P-02	9/13/06	2.9 LT	1.2	17.5	3.4	0.42 LT	0.2	1.17 M3	0.64	0.089 U	0.076	0.043 U	0.078	0.073 LT	0.046
2-MW-19-GU-P-02	2/14/07	**25** M3	6	42.4 M3	9.6	0.41 LT	0.21	1.31	0.6	0.04 U	0.055	0.056 U	0.068	0.057 LT	0.038
AVERAGE		**5.90**		**18.75**		**0.43**		**0.88**		**0.06**		**0.04**		**0.05**	
2-MW-20-GU-P-02	8/9/05	5.2 J	1.3	6.5	1.7	0.23 J	0.13	0.72 J	0.38						
2-MW-20-GU-P-02	10/13/05	2.52	0.91	6.1	1.6	0.03 U	0.15	0.63 U	0.4						
2-MW-20-GU-P-02	1/23/06	2.62	0.87	4.9	1.4	0.37	0.27	0.14 U	0.35						
2-MW-20-GU-P-02	5/3/06	1.8	1.1	4.9	1.8	0.23 J	0.15	-0.05 U	0.33	0.03 U	0.046	U	0.048	0.015 U	0.014
2-MW-20-GU-P-02	9/12/06	0.9 U	1.1	5	1.7	0.09 U	0.1	0.93 U,M	0.75	0.006 U	0.065	-0.027 U	0.035	-0.003 U	0.015
2-MW-20-GU-P-02	2/9/07	0.48 U	0.66	3.5 LT	1.4	0.09 U	0.11	0.68 U	0.47	0.052 U	0.084	-0.005 U	0.066	0.005 U	0.023
AVERAGE		**2.25**		**5.15**		**0.17**		**0.51**		**0.03**		**-0.02**		**0.01**	
2-MW-24-GU-P-02	8/10/05	0.83 UJ	0.68	10.2 J	2.2	0.74 J	0.32	0.02 U	0.36						
2-MW-24-GU-P-02	10/10/05	0.17 U	0.38	6	1.3	-0.01 U	0.13	0.04 U	0.39						
2-MW-24-GU-P-02	1/20/06	0.45 U	0.64	4.9	1.7	-0.09 U	0.13	0.07 U	0.35						
2-MW-24-GU-P-02	5/1/06	0.42 UJ	0.52	3.7	1.1	0.02 U	0.17	0.09 U	0.33	0.004 U	0.076	-0.006 U	0.067	0.016 U	0.02
2-MW-24-GU-P-02	9/8/06	0.22 U	0.4	5.6	1.4	0.09 U	0.13	0.47 U	0.39	0.025 U	0.059	0.001 U	0.06	0.022 U	0.023
2-MW-24-GU-P-02	2/8/07	0.58 U	0.57	5.7	1.5	0.036 U	0.068	0.91 LT	0.47	-0.027 U	0.074	-0.02 U	0.068	0.041 U	0.037
AVERAGE		**0.45**		**6.02**		**0.13**		**0.27**		**0.00**		**-0.01**		**0.03**	
2-MW-26-GU-P-02	8/9/05	0.7 UJ	1.1	15.5	3.3	0.03 U	0.067	0.39 U	0.35						
2-MW-26-GU-P-02	10/12/05	1.13	0.73	11.7	2.3	0.21 U	0.19	0.45 U	0.41						
2-MW-26-GU-P-02	1/24/06	2.76 J	0.86	13.2	2.5	-0.01 U	0.11	0.17 U	0.39						
2-MW-26-GU-P-02	5/1/06	4 J	1.3	13.2	2.8	0.094 U	0.069	0.05 U	0.32	0.007 U	0.077	0.05 U	0.078	0.042 J	0.031
2-MW-26-GU-P-02	9/11/06	2.6 LT	1.3	12.9	2.7	0.062 U	0.088	-0.06 U	0.44	0.015 U	0.037	-0.04 U	0.05	0.037 LT	0.029
2-MW-26-GU-P-02	2/8/07	2.8 LT	1.1	9.5	2.3	0.084 Y1,U	0.098	0.55 U	0.46	0.105 U	0.088	0.032 U	0.072	0.028 U	0.034
AVERAGE		**2.33**		**12.67**		**0.08**		**0.26**		**0.04**		**0.01**		**0.04**	
A AQUIFER AVERAGE		**1466.96**		**594.58**		**0.26**		**0.62**		**0.02**		**0.02**		**0.02**	

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
B Aquifer															
1-MW-04-GU-P-02	10/6/04	2 U	1.6	46.7 J	8.3										
1-MW-04-GU-P-04	10/6/04					0.6 J	0.28	0.63 U	0.46						
2-MW-04-GU-P-02	7/26/05	0.9 UJ	1.5	43.6	7.7	0.33 J	0.19	0.74 U	0.5						
2-MW-04-GU-P-02	10/5/05	8.2	3.1	66	12	0.77 J	0.31	1.32 J	0.53						
2-MW-04-GU-P-02	1/23/06	**16.9**	3.8	51	9	0.22 U	0.21	0.59 U	0.41						
2-MW-04-GU-P-02	5/3/06	3.3	2.1	43.4	7.7	0.23 J	0.15	0.58 U	0.43	0.031 J	0.019	0.106 J	0.057	0.002 U	0.01
2-MW-04-GU-P-02	9/12/06	2.5 U,M	2.2	54.9 M3	9.8	0.53 LT	0.24	0.87 LT	0.51	-0.001 U	0.068	0.031 U	0.049	0.009 U	0.021
2-MW-04-GU-P-02	2/8/07	2.4 U	1.6	35.2	6.2	0.34 LT	0.19	1.03	0.48	0.018 U	0.07	-0.02 U	0.059	0.015 U	0.021
2-MW-04-GU-P-17	6/27/07	2 LT	1.2	35.5	6.2	0.28 LT	0.18	0.6 U	0.44	0.062 U	0.07	0.097 U	0.064	0.022 U	0.021
AVERAGE		**4.78**		**47.04**		**0.41**		**0.80**		**0.03**		**0.05**		**0.01**	
1-MW-07-GU-P-03	10/4/04	-0.81 U	0.79	5.7 J	1.7										
1-MW-07-GU-P-04	10/4/04					0.26 J	0.18	-0.11 U	0.44						
1-MW-07-GU-P-02	8/2/05	1.27	0.78	4.7	1.6	0.16 U	0.13	0.41 U	0.36						
1-MW-07-GU-P-02	10/6/05	-0.37 U	0.49	4.2	1.1	0.022 U	0.071	0.11 U	0.34						
1-MW-07-GU-P-02	1/18/06	0.51	0.34	4.3	0.97	0.2 J	0.13	0.41 U	0.31						
1-MW-07-GU-P-02	4/28/06	1.2 J	0.71	5.4 J	1.4	0.12 U	0.11	0.39 U	0.35	0.05 U	0.073	-0.115 U	0.056	0.007 U	0.019
1-MW-07-GU-P-02	9/7/06	0.43 U	0.61	5.9	1.6	0.15 LT	0.1	0.61 U	0.45	0.059 U	0.075	-0.05 U	0.054	0.007 U	0.021
1-MW-07-GU-P-02	2/6/07	0.07 U	0.76	4.8	1.5	0.11 Y1,U	0.1	0.53 U	0.36	0.042 U	0.06	-0.009 U	0.058	0.006 U	0.019
AVERAGE		**0.33**		**5.00**		**0.15**		**0.34**		**0.05**		**-0.06**		**0.01**	
1-MW-09-GU-P-03	10/5/04	5.5 J	1.2	6.5 J	1.5										
1-MW-09-GU-P-04	10/5/04					0.15 U	0.15	0.22 U	0.48						
1-MW-09-GU-P-02	8/3/05	0.33 UJ	0.68	7.1	1.8	0.14 U	0.12	0.54 U	0.37						
1-MW-09-GU-P-02	10/5/05	0.79	0.4	6.5	1.3	0.09 U	0.1	0.72 J	0.39						
1-MW-09-GU-P-02	1/17/06	1.69	0.95	5	1.5	0.23 J	0.16	0.2 U	0.34						
1-MW-09-GU-P-02	4/27/06	0.11 UJ	0.65	6.4	2	0.036 U	0.07	0.29 U	0.37	0.029 U	0.048	-0.058 U	0.048	0.002 U	0.018
1-MW-09-GU-P-02	9/7/06	0.02 U	0.4	6.1	1.5	0.132 Y1,LT	0.096	0.33 U	0.37	0.019 U	0.078	-0.048 U	0.055	0.009 U	0.02
1-MW-09-GU-P-02	2/6/07	1.28 LT	0.75	5.8	1.6	0.018 Y1,U	0.072	0.38 U	0.35	0.02 U	0.054	-0.023 U	0.055	0.026 U	0.03
1-MW-09-GU-P-12	6/26/07	0.98 U	0.69	7.5	1.7	0.089 U	0.095	0.39 U	0.42	-0.02 U	0.059	0.073 U	0.058	0.032 U	0.025
AVERAGE		**1.34**		**6.36**		**0.11**		**0.38**		**0.01**		**-0.01**		**0.02**	
1-MW-11-GU-P-02	10/13/04	0.66 U	0.49	53.7 J	8.7	0.042 U	0.084	0.38 U	0.42						
1-MW-11-GU-P-02	8/9/05	-0.15 UJ	0.42	47	7.6	0.037 U	0.067	0.21 U	0.32						
2-MW-11-GU-D-02	10/6/05	-0.27 U	0.57	46.8	7.7	0.016 U	0.067	0.5 U	0.41						
1-MW-11-GU-P-02	1/17/06	1.58	0.84	45.8	7.7	0.062 U	0.086	-0.01 U	0.42						
1-MW-11-GU-P-02	4/27/06	-0.2 UJ	0.46	39.4	6.6	-0.003 U	0.062	0.31 U	0.39	0.13 U	0.22	0.04 U	0.22	0.026 U	0.067

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
B Aquifer Cont.															
1-MW-11-GU-P-02	9/7/06	0.16 U	0.48	45.8	7.6	-0.019 U	0.049	0.12 U	0.37	0.034 U	0.083	0.009 U	0.066	U	0.022
1-MW-11-GU-P-02	2/7/07	0.23 U	0.7	39.3	6.8	0.007 U	0.068	0.38 U	0.35	0.051 U	0.076	0.154 LT	0.09	0.021 U	0.031
AVERAGE		**0.29**		**45.40**		**0.02**		**0.27**		**0.07**		**0.07**		**0.02**	
1-MW-17-GU-P-03	10/5/04	3.1 J	1	7 J	1.6										
1-MW-17-GU-P-04	10/5/04					0.068 U	0.097	-0.13 U	0.42						
1-MW-17-GU-P-02	8/10/05	3.5 J	1.3	7.8 J	1.9	0.16 U	0.13	0.48 U	0.41						
1-MW-17-GU-P-02	10/7/05	-0.28 UJ	0.36	4.6	1	0.22 U	0.22	0.32 U	0.36						
1-MW-17-GU-P-02	1/18/06	0.87	0.4	6.7	1.4	0.12 U	0.11	0.19 U	0.31						
1-MW-17-GU-P-02	5/1/06	1.6 UJ	1	6.9	1.8	0.065 U	0.086	0.13 U	0.34	0.129 U	0.084	0.008 U	0.07	-0.003 U	0.017
1-MW-17-GU-P-02	9/8/06	0.48 U	0.51	7.8	1.7	0.25 LT	0.15	0.67 U	0.49	-0.004 U	0.052	-0.054 U	0.053	0.023 U	0.027
1-MW-17-GU-P-02	2/7/07	2.2 LT	1.1	9.3	2.1	0.22 LT	0.16	0.26 U	0.34	-0.033 U	0.082	0.001 U	0.066	-0.002 U	0.027
AVERAGE		**1.64**		**7.16**		**0.16**		**0.27**		**0.03**		**-0.02**		**0.01**	
2-MW-01-GU-P-02	10/11/04	7.3 J	2	17.2 J	3.7	0.31 J	0.14	0.62 U	0.46						
2-MW-01-GU-P-02	7/13/05	**29**	5.5	28.7	5.7	0.73 J	0.31	0.91 J	0.42						
2-MW-01-GU-P-02	10/4/05	5.2	1.5	19.5	3.7	0.46 J	0.19	0.5 U	0.45						
2-MW-01-GU-P-02	1/26/06	7.3	1.7	17.9	3.3	0.33 J	0.18	0.4 U	0.36						
2-MW-01-GU-P-02	5/4/06	8	1.7	14.8	2.8	0.53 J	0.24	0.81 J	0.43	0.007 U	0.068	0.097 U	0.071	0.013 U	0.023
2-MW-01-GU-P-02	9/14/06	6.6	2.2	17.8 M3	4.7	0.57 LT	0.25	0.72 U	0.47	0.21	0.11	0.134 LT	0.075	0.028 U	0.028
2-MW-01-GU-P-02	2/14/07	2.7 LT	1.5	9.3	2.6	0.2 Y1,LT	0.15	0.96 LT	0.47	0.002 U	0.059	0.062 U	0.056	0.018 U	0.017
2-MW-01-GU-P-03	7/16/05	10.4 J	2.4	20.6 J	4.1	0.41 J	0.17	0.73 J	0.4						
AVERAGE		**9.56**		**18.23**		**0.44**		**0.71**		**0.07**		**0.10**		**0.02**	
2-MW-03-GU-P-02	10/12/04	**4740** J	760	2600 J	410	0.55 J	0.21	1.08 J	0.55						
2-MW-03-GU-P-02	7/17/05	**6800** J	1100	3850 J	610	0.7 J	0.25	0.87 J	0.43						
2-MW-03-GU-P-03	7/18/05	**2590** J	410	1510 J	240	0.84 J	0.3	2.52 J	0.85						
2-MW-03-GU-P-02	10/4/05	**1210**	190	1070	170	0.39 J	0.17	0.81 J	0.45						
2-MW-03-GU-P-02	1/24/06	**25400** J	4100	21300	3400	0.79 J	0.3	36 J	11						
2-MW-03-GU-P-02	5/4/06	**18200**	2900	11800	1900	0.64 J	0.27	1.2 J	0.51	0.236 J	0.093	4.89 J	0.83	0.065 J	0.036
2-MW-03-GU-P-02	9/12/06	**9600** M3	1500	5360 M3	860	0.79 LT	0.26	1.01 U,M	0.7	0.067 U	0.075	3.15	0.57	0.042 U	0.043
2-MW-03-GU-P-02	2/14/07	**25400** M3	4100	13900 M3	2200	0.79 LT	0.33	0.85 LT	0.48	0.126 LT	0.079	3.74	0.67	0.049 LT	0.034
AVERAGE		**11742.50**		**7673.75**		**0.69**		**5.54**		**0.14**		**3.93**		**0.05**	
2-MW-05-GU-P-02	10/18/04	22.7 J	4.6	16.3 J	4.5	0.41 J	0.19	0.97 J	0.5						
2-MW-05-GU-P-02	7/20/05	14.2 J	3.1	21.1 J	4.3	0.71 J	0.27	0.61 U	0.42						
2-MW-05-GU-P-02	10/5/05	3.6	1.4	10.9	2.8	0.19 J	0.14	0.62 U	0.38						
2-MW-05-GU-P-02	1/25/06	7.7	2.1	16.9	3.7	0.35 J	0.18	0.67 U	0.47						

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
B Aquifer Cont.															
2-MW-05-GU-P-02	5/4/06	12	2.7	18.7	4	0.52 J	0.24	0.64 U	0.44	0.038 U	0.056	-0.042 U	0.054	0.018 U	0.023
2-MW-05-GU-P-02	9/12/06	3.2	1.9	12.4 M3	3.3	0.3 LT	0.17	0.64 U	0.49	-0.011 U	0.078	-0.008 U	0.04	0.032 U	0.026
2-MW-05-GU-P-02	2/14/07	**411**	66	227 M3	36	0.23 LT	0.15	1.39 M3	0.67	0.053 U	0.068	-0.024 U	0.057	-0.001 U	0.019
AVERAGE		**67.77**		**46.19**		**0.39**		**0.79**		**0.03**		**-0.02**		**0.02**	
2-MW-16-GU-P-02	10/12/04	**22.2** J	4.7	25.2 J	5.4	0.69 J	0.42	0.76 U	0.81						
2-MW-16-GU-P-02	8/11/05	9.6	2.3	19.6	4.1	0.42 J	0.22	0.31 U	0.41						
2-MW-16-GU-P-02	10/10/05	**19.4**	4	24.9	4.9	0.3 U	0.22	0.33 U	0.59						
2-MW-16-GU-P-02	1/20/06	2.9	1.3	13.6	3.1	0.04 U	0.14	0.11 U	0.31						
2-MW-16-GU-P-02	5/1/06	9.6 J	2.5	19.3	4.1	0.25 J	0.1	0.09 U	0.28	0.076 U	0.074	0.021 U	0.078	0.029 U	0.029
2-MW-16-GU-P-02	9/8/06	**17.8**	3.6	29.5 M3	5.6	0.19 Y1,LT	0.13	0.57 U	0.45	0.101 U	0.075	-0.058 U	0.055	0.033 U	0.032
2-MW-16-GU-P-02	2/8/07	3.6	1.3	21.6	4	0.039 U	0.084	0.3 U	0.39	-0.001 U	0.064	0.012 U	0.072	0.016 U	0.03
AVERAGE		**12.16**		**21.96**		**0.28**		**0.35**		**0.06**		**-0.01**		**0.03**	
2-MW-23-GU-P-02	8/9/05	0.59 UJ	0.7	8.5	2	0.22 J	0.13	0.63 U	0.37						
2-MW-23-GU-P-02	10/12/05	0.72 U	0.6	9.9	2	0.44 J	0.16	0.57 U	0.37						
2-MW-23-GU-P-02	1/20/06	1.38	0.83	8.9	2.1	0.14 U	0.17	0.63 U	0.41						
2-MW-23-GU-P-02	5/3/06	0.55 U	0.84	6.1	1.8	0.27 U	0.23	0.69 U	0.45	0.043 U	0.042	0.035 U	0.052	0.011 U	0.019
2-MW-23-GU-P-02	9/11/06	1 U	0.95	11.2	2.3	0.037 U	0.075	0.74 U	0.48	-0.01 U	0.054	-0.08 U	0.047	0.011 U	0.022
2-MW-23-GU-P-02	2/8/07	1.49 U	0.95	8.5	2.1	0.2 LT	0.15	1.11	0.56	0.113 U	0.095	0.098 U	0.088	0.012 U	0.024
AVERAGE		**0.96**		**8.85**		**0.22**		**0.73**		**0.05**		**0.02**		**0.01**	
3-MW-13-GU-P-02	10/14/04	0.2 U	2.4	4.8 U	5.1	0.3 J	0.18	0.35 U	0.41						
3-MW-13-GU-P-02	8/11/05	-1.1 U	1.8	11.4	4.8	0.29 J	0.19	0.59 U	0.36						
3-MW-13-GU-P-02	10/13/05	3.1	2	15.3	4.8	0.25 U	0.22	0.61 U	0.38						
3-MW-13-GU-P-02	1/24/06	3.9 J	2.4	15.9	4.9	0.16 U	0.12	0.08 U	0.37						
3-MW-13-GU-P-02	9/12/06	0.4 U	1.7	12.8 M3	4	0.27 LT	0.16	1.07 M3	0.61	0.059 U	0.073	-0.003 U	0.039	0.033 LT	0.025
3-MW-13-GU-P-02	2/9/07	1.2 U,M	2	-4.5 U,M	5.3	0.3 LT	0.18	0.64 U	0.47	0.096 U	0.085	-0.019 U	0.059	0.004 U	0.021
AVERAGE		**1.28**		**9.28**		**0.26**		**0.56**		**0.08**		**-0.01**		**0.02**	
3-MW-14-GU-P-02	10/14/04	12.2 J	3.8	8.1 J	4.6	0.41 J	0.21	0.56 U	0.49						
3-MW-14-GU-P-02	8/11/05	3.1	1.8	10.2	3.6	0.064 U	0.093	0.7 J	0.38						
3-MW-14-GU-P-02	10/13/05	2.6 U	1.8	9.2	3.5	0.24 U	0.21	0.78 U	0.47						
3-MW-14-GU-P-02	1/25/06	14.6	3.3	10.4	3.6	0.25 J	0.15	0.9 J	0.52						
3-MW-14-GU-P-02	9/13/06	2.3 U,M	2.8	6.5 M3	3.6	0.29 LT	0.17	0.79 LT	0.46	-0.009 U	0.062	-0.087 U	0.057	-0.014 U	0.024
3-MW-14-GU-P-02	2/9/07	2.9 U,M	2.2	7 M3	3.5	0.19 LT	0.15	1.91 M3	0.83	-0.018 U	0.073	-0.007 U	0.065	0.011 U	0.024
AVERAGE		**6.28**		**8.57**		**0.24**		**0.94**		**-0.01**		**-0.05**		**0.00**	
B AQUIFER AVERAGE		**1101.07**		**732.59**		**0.28**		**1.01**		**0.05**		**0.33**		**0.02**	

Table 4-26
Radiochemical Analysis of Groundwater, Operable Units 1 and 2
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (RA-226/288 combined)		5 (RA-226/288 combined)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
C Aquifer															
2-MW-25-GU-P-02	11/18/05	5.7 J	2.7	13.3 J	4.9	0.96 J	0.37	1.03 J	0.5						
2-MW-25-GU-P-02	1/24/06	7.8 J	3.7	252	41	1.53 J	0.5	1.49 J	0.6						
2-MW-25-GU-P-02	5/3/06	0.7 U	3.7	263	43	0.42 J	0.21	0.83 J	0.44	0.008 U	0.057	-0.001 U	0.045	0.008 U	0.012
2-MW-25-GU-P-02	9/11/06	0.9 U,M	3.5	174 M3	29	0.34 Y1,LT	0.18	1.26	0.58	-0.017 U	0.062	0.008 U	0.059	0.014 U	0.024
2-MW-25-GU-P-02	2/8/07	4 U,M	3.1	116 M3	20	0.89 LT	0.35	1.22	0.52	0.028 U	0.067	0.047 U	0.071	0.009 U	0.021
AVERAGE		**3.82**		**163.66**		**0.83**		**1.17**		**0.01**		**0.02**		**0.01**	

Notes:

MCL = Maximum Contaminant Level
TPU=Total Propagated Uncertainty
J=Result is an estimated value
LT=Result is less than requested MDC but greater than sample specific MDC
M=The requested MDC not met
M3=The requested MDC was not met, byt the reported activity is grreater than the reported MDC.
TI=Nuclide identification is tentative
U=Result is less than the sample specific MDC
Y1=Chemical yield is in control at 100-100%. Quantative yield is assumed.
Shading indicates detected concentrations which equal or exceed the MCLs

Table 4-27
Metals Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2

Analyte		ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD		MANGANESE		VANADIUM	
NJDEP WQC (mg/L)		0.006		0.003		0.07		0.3		0.005		0.05		NA	
Region 6 PRG (mg/L)		**0.0146**		**0.00004**		**NA**		**25.55**		**0.015**		**1.70309**		**0.1825**	
Sample ID	**Sample Date**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
A Aquifer															
1-MW-06-GU-P-02	8/2/05			0.013	J										
1-MW-06-GU-P-02	10/6/05			0.012											
1-MW-06-GU-P-02	9/7/06			0.014											
1-MW-08-GU-P-02	8/10/05	0.041		0.01											
1-MW-10-GU-P-02	10/21/04									0.016	J				
1-MW-10-GU-P-02	8/16/05			0.045	J										
1-MW-10-GU-P-02	10/10/05			0.015											
1-MW-10-GU-P-02	9/7/06			0.015											
1-MW-10-GU-P-02	2/12/07			0.015											
1-MW-18-GU-P-02	8/10/05			0.013											
1-MW-21-GU-P-02	8/10/05											3.1	J		
1-MW-21-GU-P-02	10/7/05							28	J			3.5			
1-MW-21-GU-P-02	1/19/06							41	J			4.6			
1-MW-21-GU-P-02	5/1/06							41	J			4.2			
1-MW-21-GU-P-02	9/7/06			0.014				34				3.8			
1-MW-22-GU-P-02	8/11/05			0.015	J										
1-MW-22-GU-P-02	10/7/05			0.026											
1-MW-22-GU-P-02	4/28/06			0.012											
1-MW-22-GU-P-02	9/8/06			0.015											
2-MW-02-GU-P-02	10/25/04									0.047	J				
2-MW-02-GU-P-02	8/3/05	0.022													
2-MW-12-GU-P-08	10/6/04	0.021	J	0.015	J										
2-MW-12-GU-P-02	8/3/05			0.018											
2-MW-12-GU-P-02	10/11/05			0.014											
2-MW-12-GU-P-02	5/3/06			0.01											
2-MW-12-GU-P-02	9/8/06	0.033		0.012											
2-MW-12-GU-P-02	2/8/07	0.04													
2-MW-15-GU-P-02	8/10/05			0.019											
2-MW-15-GU-P-02	10/14/05	0.03													
2-MW-15-GU-P-02	5/9/06	0.054													
2-MW-15-GU-P-02	9/13/06	0.058													
2-MW-19-GU-P-02	8/25/05			0.025											
2-MW-19-GU-P-02	10/14/05			0.022				30	J						

Table 4-27
Metals Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD		MANGANESE		VANADIUM	
NJDEP WQC (mg/L)		0.006		0.003		0.07		0.3		0.005		0.05		NA	
Region 6 PRG (mg/L)		**0.0146**		**0.00004**		**NA**		**25.55**		**0.015**		**1.70309**		**0.1825**	
Sample ID	**Sample Date**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
A Aquifer															
2-MW-19-GU-P-02	1/24/06			0.01	J			31	J						
2-MW-19-GU-P-02	9/13/06			0.021				26							
2-MW-19-GU-P-02	2/14/07			0.012				29							
his CF is consistent with th	10/13/05			0.022											
2-MW-20-GU-P-02	1/23/06			0.016											
2-MW-20-GU-P-02	5/3/06			0.018											
2-MW-20-GU-P-02	9/12/06			0.04											
2-MW-20-GU-P-02	2/9/07			0.018											
2-MW-24-GU-P-02	8/10/05			0.019											
2-MW-24-GU-P-02	10/10/05			0.018											
2-MW-24-GU-P-02	1/20/06			0.012											
2-MW-24-GU-P-02	5/1/06			0.011											
2-MW-24-GU-P-02	9/8/06			0.016											
2-MW-24-GU-P-02	2/8/07			0.014											
2-MW-26-GU-P-02	8/9/05	0.031		0.061											
2-MW-26-GU-P-02	10/12/05	0.025		0.067						0.019					
2-MW-26-GU-P-02	1/24/06			0.035	J					0.031	J				
2-MW-26-GU-P-02	5/1/06			0.048						0.018					
2-MW-26-GU-P-02	9/11/06			0.053						0.031				0.19	
2-MW-26-GU-P-02	2/8/07			0.035						0.029					
AVERAGE		**0.04**		**0.02**		**NA**		**32.50**		**0.03**		**3.84**		**0.19**	
B Aquifer															
1-MW-07-GU-P-12	10/4/04			0.015	J							2	J		
1-MW-07-GU-P-02	8/2/05			0.012	J							2	J		
1-MW-07-GU-P-02	10/6/05			0.015								1.9			
1-MW-07-GU-P-02	1/18/06											2.1			
1-MW-07-GU-P-02	4/28/06			0.01								1.9			
1-MW-07-GU-P-02	9/7/06			0.015								1.8			
1-MW-07-GU-P-02	2/6/07			0.014								1.9			
1-MW-11-GU-P-02	8/9/05	0.022													
2-MW-11-GU-D-02	10/6/05			0.011											
1-MW-11-GU-P-02	9/7/06			0.011											

Table 4-27
Metals Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD		MANGANESE		VANADIUM	
NJDEP WQC (mg/L)		0.006		0.003		0.07		0.3		0.005		0.05		NA	
Region 6 PRG (mg/L)		**0.0146**		**0.00004**		**NA**		**25.55**		**0.015**		**1.70309**		**0.1825**	
Sample ID	**Sample Date**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
B Aquifer Cont.															
1-MW-17-GU-P-12	10/5/04			0.012	J			28	J	1.6	J	5.8	J		
1-MW-17-GU-P-02	8/10/05			0.017				46	J			5.2	J		
1-MW-17-GU-P-02	10/7/05			0.012				53	J			5.6			
1-MW-17-GU-P-02	1/18/06							51	J			5.5			
1-MW-17-GU-P-02	5/1/06			0.012				50	J	0.074		5.2			
1-MW-17-GU-P-02	9/8/06			0.014				43				4.5			
1-MW-17-GU-P-02	2/7/07											2			
2-MW-01-GU-P-02	10/11/04			0.02											
2-MW-01-GU-P-02	7/13/05			0.02	J										
2-MW-01-GU-P-03	7/16/05			0.02											
2-MW-01-GU-P-02	10/4/05			0.024											
2-MW-01-GU-P-02	1/26/06			0.018											
2-MW-01-GU-P-02	9/14/06			0.035				32				1.9			
2-MW-01-GU-P-02	2/14/07			0.036				28							
2-MW-03-GU-P-02	10/12/04			0.023	J					0.34	J	3.1	J		
2-MW-03-GU-P-02	7/17/05			0.017				41	J						
2-MW-03-GU-P-02	10/4/05			0.02				40	J	0.032					
2-MW-03-GU-P-02	1/24/06			0.013	J			34	J	0.026	J				
2-MW-03-GU-P-02	9/12/06							40							
2-MW-03-GU-P-02	2/14/07							30							
2-MW-03-GU-P-03	7/18/05			0.017				38	J	0.036					
2-MW-05-GU-P-02	10/18/04			0.046	J										
2-MW-05-GU-P-02	7/20/05			0.052											
2-MW-05-GU-P-02	10/5/05			0.038											
2-MW-05-GU-P-02	9/12/06			0.035											
2-MW-05-GU-P-02	2/14/07			0.024											
2-MW-16-GU-P-02	10/12/04			0.023	J	0.24	J	41	J	0.016	J			0.62	J
2-MW-16-GU-P-02	8/11/05					0.13	J							0.4	J
2-MW-16-GU-P-02	10/10/05			0.013		0.21								0.62	
2-MW-16-GU-P-02	5/1/06					0.12								0.35	
2-MW-16-GU-P-02	9/8/06					0.16								0.49	
2-MW-23-GU-P-02	8/9/05			0.022											

Table 4-27
Metals Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2
(cont.)

Analyte		ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD		MANGANESE		VANADIUM	
NJDEP WQC (mg/L)		0.006		0.003		0.07		0.3		0.005		0.05		NA	
Region 6 PRG (mg/L)		**0.0146**		**0.00004**		**NA**		**25.55**		**0.015**		**1.70309**		**0.1825**	
Sample ID	**Sample Date**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
2-MW-23-GU-P-02	10/12/05			0.023											
2-MW-23-GU-P-02	1/20/06			0.027											
2-MW-23-GU-P-02	5/3/06			0.02											
2-MW-23-GU-P-02	9/11/06			0.019											
2-MW-23-GU-P-02	2/8/07			0.024											
3-MW-13-GU-P-02	10/14/04							230	J			16			
3-MW-13-GU-P-02	8/11/05							190	J			11	J		
3-MW-13-GU-P-02	10/13/05							170	J			11	J		
3-MW-13-GU-P-02	1/24/06							190	J			11	J		
3-MW-13-GU-P-02	5/2/06							170	J			9.4			
3-MW-13-GU-P-02	9/12/06							160				11			
3-MW-13-GU-P-02	2/9/07							200				12			
3-MW-14-GU-P-02	10/14/04							42	J	24		11			
3-MW-14-GU-P-02	8/11/05			0.014	J					0.13	J				
3-MW-14-GU-P-02	10/13/05			0.017											
3-MW-14-GU-P-02	5/2/06									0.22					
3-MW-14-GU-P-02	9/13/06			0.014						1.6					
3-MW-14-GU-P-02	2/9/07			0.013						0.022					
AVERAGE		**N/A**		**0.02**		**0.17**		**84.65**		**2.34**		**6.03**		**0.50**	
C Aquifer															
2-MW-25-GU-P-02	11/18/05							180	J			8.8	J		
2-MW-25-GU-P-02	9/11/06							180				6.5			
2-MW-25-GU-P-02	2/8/07							410				14			
AVERAGE		**N/A**		**N/A**		**N/A**		**256.67**		**N/A**		**9.77**		**N/A**	

Notes:

mg/L = milligrams per liter

N/A = Not Applicable

NJDEP WQC = New Jersey Department of Environmental Protection Water Quality Criteria

J = Estimated result

PRG = Preliminary Remediation Goal

Table 4-28
BTEX Concentrations in Groundwater, Operable Units 1 and 2

Analyte		Benzene		Toluene		Ethylbenzene		o-Xylene		m,p-Xylene		Total Xylene		Total BTEX	
MCL (µg/L)		5		1,000		700		N/A		N/A		10,000		N/A	
Well ID	Sample Date	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (ug/L)	Flag	Result (µg/L)	Flag
A Aquifer															
1-MW-06	8/2/05	**5**	U	5	U	5	U	5	U	5	U	N/A	N/A	0	N/A
1-MW-08	8/10/05	**5**	U	5	U	5	U	5	U	5	U	N/A	N/A	0	N/A
1-MW-10	8/16/05	4.3	J	1.2	J	0.97	U	1.2	J	2.1	J	3.3	N/A	6.7	N/A
1-MW-18	8/10/05	**94**		59		120		92		210		302	N/A	365	N/A
1-MW-21	8/10/05	**1900**		890		**1500**		2500		3600		6100	N/A	6790	N/A
1-MW-22	8/11/05	**12000**		**18000**		**2700**		8400		17000		**25400**	N/A	41100	N/A
2-MW-02	8/3/05	**750**		400	J	**890**		1300		1900		3200	N/A	3340	N/A
2-MW-12	8/3/05	**160**		76		200		220		490		710	N/A	656	N/A
2-MW-15	8/10/05	2.6	J	5	U	5	U	5	U	5	U	N/A	N/A	2.6	N/A
2-MW-19	8/25/05	**4700**		**1900**		**7600**		10000		22000		**32000**	N/A	24200	N/A
2-MW-20	8/9/05	**370**		**1500**		**1500**		1800		2500		4300	N/A	5170	N/A
2-MW-24	8/10/05	2.4	J	1.4	J	1.1	J	1.5	J	2.1	J	3.6	N/A	6.4	N/A
2-MW-26	8/9/05	**30**		5.6	J	48		29		100		129	N/A	112.6	N/A
3-MW-14	8/11/05	**11**		2.5	J	10	U	10	U	10	U	N/A	N/A	13.5	N/A
B Aquifer															
1-MW-07	8/2/05	**7700**		390	J	**2600**		770		1200		1970	N/A	11460	N/A
1-MW-09	8/3/05	**50**	U	50	U	50	U	9.5	J	13	J	22.5	N/A	9.5	N/A
1-MW-11	8/9/05	**340**		170		140		190		410		600	N/A	840	N/A
1-MW-17	8/10/05	**7700**		**9200**		**2200**		4100		8000		**12100**	N/A	23200	N/A
2-MW-01	7/13/05	**9100**		**13000**		**2900**		6900		13000		**19900**	N/A	44900	N/A
2-MW-03	7/17/05	**3400**		**5000**		**1200**		2100		4000		6100	N/A	11700	N/A
2-MW-04	7/26/05	4	J	1.4	J	5	U	5	U	5	U	N/A	N/A	5.4	N/A
2-MW-05	7/20/05	**2900**		170	J	**1300**		5	U	600		600	N/A	4370	N/A
2-MW-16	8/11/05	**50**	U	50	U	50	U	50	U	50	U	N/A	N/A	0	N/A
2-MW-23	8/9/05	**3400**		490		**3700**		2600		6400		9000	N/A	10190	N/A
3-MW-13	8/11/05	**360**		100	U	100	U	100	U	100	U	N/A	N/A	360	N/A

Notes:

µg/L = Micrograms per liter
MCL = Maximum Contaminant Level
N/A = Not applicable
Qual = Qualifier
Total BTEX = Benzene, toluene, ethylbenzene, and xylene
Total xylene = o-xylene and m,p-xylene
J = Concentration of analyte is estimated
U = Analyte not detected
Shading indicates detected concentrations that equal or exceed the MCL

Table 4-29
Organic Compounds Detections in LNAPL

Well ID	Sample Date	Analyte	Result (mg/kg)	Lab Qualifer
2-MW-01B	10/13/05	**VOCs**		
		1,2,4-TRIMETHYLBENZENE	45000	E
		1,3,5-TRIMETHYLBENZENE	14000	
		BENZENE	2200	
		CHLOROBENZENE	52000	E
		ETHYLBENZENE	12000	
		ISOPROPYLBENZENE	1600	
		m,p-XYLENE	66000	E
		METHYLENE CHLORIDE	920	
		N-BUTYLBENZENE	1600	
		N-PROPYLBENZENE	2300	
		o-XYLENE	29000	E
		P-ISOPROPYLTOLUENE	580	J
		STYRENE	9000	
		TOLUENE	13000	
		SVOCs		
		1,4-DICHLOROBENZENE	93	J
		ACENAPHTHENE	1500	
		ACENAPHTHYLENE	510	J
		ANTHRACENE	910	J
		BENZO(A)ANTHRACENE	490	J
		BENZO(B)FLUORANTHENE	190	J
		BENZO(K)FLUORANTHENE	81	J
		BENZO(A)PYRENE	180	J
		BIS(2-ETHYLHEXYL)PHTHALATE	97	J
		CHRYSENE	1400	
		DIBENZOFURAN	460	J
		FLUORANTHENE	780	J
		FLUORENE	1600	
		2-METHYLNAPHTHALENE	27000	E
		NAPHTHALENE	68000	E
		PHENANTHRENE	3600	
		PYRENE	740	J
		Uranium		
		Total Uranium	0.41 pCi/g	

Notes:

MCL = Maximum Contaminant Level

mg/kg = milligrams per kilogram

pCi/g = picocuries per gram

E = Analyte concentration exceeds upper level of concentration range

J = reported concentration is estimated

LNAPL = Light Non Aqueous Phase Liquid

VOCs = volatile organic compounds

SVOCs = semivolatile organic compounds

Table 4-30
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2

		SVOC	VOC												
		NAPHTHALENE	1,2,4-TRICHLOROBENZENE	1,2,4-TRIMETHYLBENZENE	1,2-DIBROMO-3-CHLOROPROPANE	1,2-DICHLOROBENZENE	1,2-DICHLOROETHANE	1,3,5-TRIMETHYLBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	BENZENE	CARBON DISULFIDE	CARBON TETRACHLORIDE	CHLOROBENZENE	CHLOROFORM	ETHYLBENZENE
NJDEP WQC (ug/L)		300	9	NA	0.02	600	2	NA	600	75	1	700	1	50	70	700
Region 6 PRG (ug/L)		**6.2**	**8.16**	**12.4**	**0.000204**	**49.3**	**0.123**	**12.3**	**14.5**	**0.467**	**0.354**	**1043**	**0.171**	**91.3**	**0.167**	**1340**
Sample ID	**Sample Date**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**
A Aquifer																
1-MW-08-GU-P-02	8/10/05															
1-MW-10-GU-P-02	8/16/05									3.5 J	4.3 J					
1-MW-18-GU-P-02	8/10/05			250	29 J			72			94					
1-MW-21-GU-P-02	8/10/05			1200				270			1900			150 J		1500
1-MW-22-GU-P-02	8/11/05			1300				450 J			12000			120 J		2700
2-MW-02-GU-P-02	8/3/05			350				160		16	420					
2-MW-12-GU-P-02	8/3/05			220				56			160					
2-MW-15-GU-P-02	8/10/05										2.6 J					
2-MW-19-GU-P-02	8/25/05			2700		2500		700	140 J	4000	4700			20000		7600
2-MW-20-GU-P-02	8/9/05			1400		73 J		320		160 J	370			350		1500
2-MW-24-GU-P-02	8/10/05									1.3 J	2.4 J					
2-MW-26-GU-P-02	8/9/05			44							30					
A AQUIFER AVERAGE		**N/A**	**N/A**	**933.00**	**N/A**	**1286.50**	**N/A**	**289.71**	**N/A**	**836.16**	**1789.39**	**N/A**	**N/A**	**5155.00**	**N/A**	**3325.00**
B Aquifer																
1-MW-07-GU-P-02	8/2/05			1100		290 J		350 J		570	7700			8700		2600
1-MW-09-GU-P-02	8/3/05			68				17 J								
1-MW-09-GU-P-12	6/26/07	1500		56				13			0.52 J					
1-MW-11-GU-P-02	8/9/05			54				16		3.7 J	340					
1-MW-17-GU-P-02	8/10/05			1500				400			7700				83 J	2200
2-MW-01-GU-P-02	7/13/05			2600				1000			9100			19000		2900
2-MW-03-GU-P-02	7/17/05			920				360 J			3400			1100		
2-MW-04-GU-P-02	7/26/05									1.7 J	4 J			99 J		
2-MW-04-GU-P-17	6/27/07									1.2	0.41 J					
2-MW-05-GU-P-02	7/20/05			970		100 J	65 J	220 J		180 J	2900			5700		
2-MW-16-GU-P-02	8/11/05											1500				
2-MW-23-GU-P-02	8/9/05		130 J	1800		2200		430	150 J	3900	3400			5300		3700
3-MW-13-GU-P-02	8/11/05		340				29 J			58 J	360		53 J	390	450	
3-MW-14-GU-P-02	8/11/05									14	11			210	2.3 J	
B AQUIFER AVERAGE		**N/A**	**235.00**	**1007.56**	**N/A**	**863.33**	**47.00**	**311.78**	**N/A**	**591.08**	**2909.66**	**N/A**	**N/A**	**5062.38**	**178.43**	**2850.00**

Table 4-30
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, Operable Units 1 and 2
(cont.)

		VOC's (cont.)											
		ISOPROPYLBENZENE	METHYLENE CHLORIDE	NAPHTHALENE	N-BUTYLBENZENE	N-PROPYLBENZENE	O-XYLENE	SEC-BUTYLBENZENE	STYRENE	TETRACHLOROETHENE	TOLUENE	TRICHLOROFLUOROMETHANE	VINYL CHLORIDE
NJDEP WQC (ug/L)		700	3	300	NA	NA	NA	NA	100	1	600	2000	1
Region 6 PRG (ug/L)		**658**	**4.28**	**6.2**	**60.8**	**60.8**	**1431**	**60.8**	**1641**	**0.105**	**2281**	**1288**	**0.015**
Sample ID	**Sample Date**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**
A Aquifer													
1-MW-08-GU-P-02	8/10/05		5.6	25									
1-MW-10-GU-P-02	8/16/05												
1-MW-18-GU-P-02	8/10/05		47	6100									
1-MW-21-GU-P-02	8/10/05			14000	200 J		2500						
1-MW-22-GU-P-02	8/11/05		160 J	3200			8400		4000		18000		
2-MW-02-GU-P-02	8/3/05			870									
2-MW-12-GU-P-02	8/3/05		12 J	3300									
2-MW-15-GU-P-02	8/10/05		5.8										
2-MW-19-GU-P-02	8/25/05		1800	11000		120 J	10000						
2-MW-20-GU-P-02	8/9/05			11000	630		1800						
2-MW-24-GU-P-02	8/10/05		5.8	52									2.7 J
2-MW-26-GU-P-02	8/9/05		57	940									
A AQUIFER AVERAGE		**N/A**	**261.65**	**5048.7**	**415**	**N/A**	**5675**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
B Aquifer													
1-MW-07-GU-P-02	8/2/05	970	250 J	3900	860	400 J							
1-MW-09-GU-P-02	8/3/05			2500									
1-MW-09-GU-P-12	6/26/07			1600									
1-MW-11-GU-P-02	8/9/05		11	260									
1-MW-17-GU-P-02	8/10/05			16000	260		4100				9200		
2-MW-01-GU-P-02	7/13/05			9500	94 J	150 J	6900	86 J	3000		14000		
2-MW-03-GU-P-02	7/17/05			7000		67 J	2100				5000		
2-MW-04-GU-P-02	7/26/05												
2-MW-04-GU-P-17	6/27/07												0.17 J
2-MW-05-GU-P-02	7/20/05			9100									
2-MW-16-GU-P-02	8/11/05												
2-MW-23-GU-P-02	8/9/05			10000		66 J	2600						
3-MW-13-GU-P-02	8/11/05		30 J							85 J		1900	
3-MW-14-GU-P-02	8/11/05												
B AQUIFER AVERAGE		**N/A**	**97.00**	**6651.11**	**404.67**	**170.75**	**3925.00**	**N/A**	**N/A**	**N/A**	**9400.00**	**N/A**	**N/A**

Notes:

N/A = Not Applicable
ug/L = Micrograms per liter
NJDEP WQC = New Jersey Department of Environmental Protection Water Quality Criteria
PRG = Preliminary Remediation Goal
J = Estimated Result

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Table 5-1
Soil Geotechnical Parameters, AOC 3

Sample ID	Depth Interval [ft bgs]	Soil pH [SW 9045c]	Specific Gravity [ASTM D854]	Moisture Content [ASTM D2216]	Liquid Limit [ASTM D4318]	Plastic Limit [ASTM D4318]	Atterburg Classification [ASTM D4318]	Percent Silt & Clay [ASTM D422]
3-SB-01-B-0-04	6-8	5.3	2.69	30.1	36.2	19.3	CL*	99.1
3-SB-07-B-0-03	4-6	4.3	2.72	24.8	30.9	17.3	CL	63
3-SB-14-B-0-05	8-10	4.4	2.71	30.2	37	19.9	CL	92.4
3-SB-16-B-0-04	6-8	4.4	2.76	15.3	27	14.2	CL	51.7

Notes:

ft bgs = Feet below ground surface

* CL = Clay

** NP = non-plastic

Table 5-2
Soil Geotechnical Parameters, AOC 5

Sample ID	Depth Interval [ft bgs]	Soil pH [SW 9045c]	Specific Gravity [ASTM D854]	Moisture Content [ASTM D2216]	Liquid Limit [ASTM D4318]	Plastic Limit [ASTM D4318]	Atterburg Classification [ASTM D4318]	Percent Silt & Clay [ASTM D422]
5-SB-05-B-0-03	4-6	6.9	2.68	16.1	NP**	NP	NP	24.6
5-SB-10-B-1-04	6-8	8.2	2.64	57.5	28.9	18.7	CL	43

Notes:

ft bgs = Feet below ground surface

* CL = Clay

** NP = Non-plastic

Table 5-3
Total Uranium Results for Soil Samples, AOC 3

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
					Uranium (Total)			Uranium (Total)		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
3-MW-13B	3-MW-13-B-P-01	9/24/04	2	3	0.2 U	1.1	1.9			
	3-MW-13-B-P-02	9/24/04	6	7	1.1 U	1.8	3.1			
3-MW-14B	3-MW-14-B-P-01	9/23/04	2	3	0.4 U	2.2	3.7			
	3-MW-14-B-P-02	9/23/04	6	7	1.1 U	1.3	2.2			
3-SB-01	3-SB-01-B-0-02	8/13/03	2	4	3.3 U	2.7	4.1	11.2	4.71	1.31
	3-SB-01-B-0-03 (4'-6')	8/13/03	4	6				1.75	1.9	1.14
	3-SB-01-B-0-04 (6'-8')	8/13/03	6	8				4.45 U		1.49
	3-SB-01-B-0-05	8/13/03	8	10	2.7 U	2.2	3.5	1.65	1.53	0.89
3-SB-02	3-SB-02-B-0-02 (2'-4')	8/13/03	2	4				-2.38 U		1.01
	3-SB-02-B-0-03 (4'-6')	8/13/03	4	6				1.68	1.58	0.923
	3-SB-02-B-0-04 (6'-8')	8/13/03	6	8				4.35 U		1.38
	3-SB-02-B-0-05	8/13/03	8	10	1.1 U	1.7	2.9	0.754 U		1.42
3-SB-03	3-SB-03-B-0-02 (2'-4')	8/12/03	2	4				2.49 U		1.2
	3-SB-03-B-0-03 (4'-6')	8/12/03	4	6				-1.35 U		1.84
	3-SB-03-B-0-04 (6'-8')	8/12/03	6	8				1.69 U		1.54
	3-SB-03-B-0-05 (8'-10')	8/12/03	8	10	1.7 U	1.6	2.5	0.932 U		1.12
3-SB-04	3-SB-04-B-0-02 (2'-4')	8/12/03	2	4				1.71	1.53	0.877
	3-SB-04-B-0-03 (4'-6')	8/12/03	4	6				3.72 U		1.43
	3-SB-04-B-0-04 (6'-8')	8/12/03	6	8				1.53	1.94	1.19
	3-SB-04-B-0-05 (8'-10')	8/12/03	8	10	4.1 U	4.1	6.5	1.48 U		1.28
3-SB-05	3-SB-05-B-0-02	8/11/03	2	4	**17.2**	5.7	7.2	**35.3**	13.6	1.84
	3-SB-05-B-0-03 (4'-6')	8/11/03	4	6				3.09	1.97	0.985
	3-SB-05-B-0-04 (6'-8')	8/11/03	6	8				4.14	2.53	1.24
	3-SB-05-B-0-05	8/11/03	8	10	-0.2 U	4.1	7.4	1.81 U		0.987
3-SB-06	3-SB-02-B-0-02 (2'-4')	8/13/03	2	4	3.3 U	3.9	6.3	4.84	2.96	1.39
	3-SB-06-B-0-03 (4'-6')	8/13/03	4	6				2.12 U		1.65
	3-SB-06-B-0-04 (6'-8')	8/13/03	6	8				3.85 U		1.69
	3-SB-06-B-0-05 (8'-10')	8/13/03	8	10	1.8 U	2.2	3.5	-1.19 U		1.07
3-SB-07	3-SB-07-B-0-02 (2'-4')	8/14/03	2	4				5.03 U		1.7
	3-SB-07-B-0-03 (4'-6')	8/14/03	4	6	0.3 U	1.8	3.1	0.712 U		1.23
	3-SB-07-B-0-04 (6'-8')	8/14/03	6	8				-0.594 U		1.05
	3-SB-07-B-0-06 (6'-8')	8/14/03	6	8				-1.02 U		0.91
	3-SB-07-B-0-05 (8'-10')	8/14/03	8	10	0.2 U	1.7	2.9	-0.155 U		0.861
3-SB-08	3-SB-08-B-0-01 (0'-2')	8/7/03	0	2				3.66 U		1.02
	3-SB-08-B-0-02 (2'-4')	8/7/03	2	4				1.72 U		0.969
	3-SB-08-B-0-03 (4'-6')	8/7/03	4	6	0.8 U	4.5	7.8	4.89 U		1.43
	3-SB-08-B-0-04 (4'-6')	8/7/03	4	6				-0.223 U		1.3
	3-SB-08-B-0-05 (8'-10')	8/7/03	8	10	3.9 U	4.3	7	2.22 U		1.3
3-SB-09	3-SB-09-B-0-01 (0'-2')	8/8/03	0	2	**14.7**	4.3	5.1	**15.3**	6.28	1.39
	3-SB-09-B-0-02 (2'-4')	8/8/03	2	4				4.48	3.53	1.96
	3-SB-09-B-0-03 (4'-6')	8/8/03	4	6				0.14 U		1.16
	3-SB-09-B-0-04 (6'-8')	8/8/03	6	8				2.42 U		1.5
	3-SB-09-B-0-05 (8'-10')	8/8/03	8	10	5.9 U	4.7	7.2	-0.258 U		1.13
3-SB-10	3-SB-10-B-0-01 (0'-2')	8/11/03	0	2				0.346 U		1.06
	3-SB-10-B-0-02 (2'-4')	8/11/03	2	4	1.1 U	1.7	2.9	1.76 U		1.03
	3-SB-10-B-0-03 (4'-6')	8/11/03	4	6				1.59 U		1.09
	3-SB-10-B-0-04 (6'-8')	8/11/03	6	8				-0.00673 U		1.52
	3-SB-10-B-0-05 (8'-10')	8/11/03	8	10	0.3 U	2	3.5	1.81 U		1.47
3-SB-11	3-SB-11-B-0-02 (2'-4')	8/14/03	2	4				4.55 U		1.3
	3-SB-11-B-0-03 (4'-6')	8/14/03	4	6				2.38 U		1.61
	3-SB-11-B-0-04 (6'-8')	8/14/03	6	8	1.6 U	2.7	4.3	0.143 U		0.932
	3-SB-11-B-0-05 (8'-10')	8/14/03	8	10	-0.1 U	1.5	2.7	1.4 U		0.93
3-SB-12	3-SB-12-B-0-02 (2'-4')	8/15/03	2	4	1.6 U	4.5	7.8	4.95 U		1.69

Table 5-3
Total Uranium Results for Soil Samples, AOC 3
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
					Uranium (Total)			Uranium (Total)		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
3-SB-12	3-SB-12-B-0-03 (4'-6')	8/15/03	4	6				5.55 U		1.82
	3-SB-12-B-0-04 (6'-8')	8/15/03	6	8				3.53 U		1.46
	3-SB-12-B-0-05 (8'-10')	8/15/03	8	10	-2.9 U	4.1	7.4	0.469 U		1.27
3-SB-13	3-SB-13-B-0-02 (2'-4')	8/19/03	2	4				7.43 U		1.94
	3-SB-13-B-0-03 (4'-6')	8/19/03	4	6				0.633 U		1.43
	3-SB-13-B-0-04 (6'-8')	8/19/03	6	8	2 U	4.3	7.4	-0.709 U		1.29
	3-SB-13-B-0-05 (8'-10')	8/19/03	8	10	-0.6 U	4.3	7.6	2.4	1.75	0.944
3-SB-14	3-SB-14-B-0-02 (2'-4')	8/18/03	2	4				1.77	1.68	0.978
	3-SB-14-B-0-03 (4'-6')	8/18/03	4	6	2.9 U	2.7	4.3	2.25	2.15	1.26
	3-SB-14-B-0-04 (6'-8')	8/18/03	6	8				3.64 U		1.51
	3-SB-14-B-0-05 (8'-10')	8/18/03	8	10	1.6 U	4.5	7.8	0.23 U		1.02
3-SB-15	3-SB-15-B-0-02 (2'-4')	8/20/03	2	4				2.62 U		1.25
	3-SB-15-B-1-02 (2'-4')	8/20/03	2	4				0.631 U		0.838
	3-SB-15-B-0-03 (4'-6')	8/20/03	4	6				2.05 U		1.57
	3-SB-15-B-1-03 (4'-6')	8/20/03	4	6				0.929 U		1.22
	3-SB-15-B-0-04 (6'-8')	8/20/03	6	8	1.6 U	4.3	7.2	2.37	1.74	0.941
	3-SB-15-B-1-04 (6'-8')	8/20/03	6	8				1.9	1.78	1.04
	3-SB-15-B-0-05 (8'-10')	8/20/03	8	10	0.6 U	1.3	2.2	0.929 U		0.836
	3-SB-15-B-1-05 (8'-10')	8/20/03	8	10				3.06 U		1.42
3-SB-16	3-SB-16-B-0-03 (4'-6')	8/19/03	4	6				-0.88 U		1.17
	3-SB-16-B-0-04 (6'-8')	8/19/03	6	8	-1.6 U	4.3	7.4	2.33	1.69	0.897
	3-SB-16-B-0-05 (8'-10')	8/19/03	8	10	1.2 U	2	3.5	-0.0552 U		1.34
3-SB-17	3-SB-17-B-0-02 (2'-4')	8/22/03	2	4				4	1.99	0.754
	3-SB-17-B-0-03 (4'-6')	8/22/03	4	6	5.5	2.5	3.5	9.87	4.48	1.53
	3-SB-17-B-0-04 (6'-8')	8/22/03	6	8				0.636 U		1.23
	3-SB-17-B-0-05 (8'-10')	8/22/03	8	10	-0.6 U	3.3	5.9	0.945 U		0.921
3-SB-18	3-SB-18-B-0-02 (2'-4')	8/25/03	2	4	1.2 U	2	3.5	-2.09 U		1.17
	3-SB-18-B-0-03 (4'-6')	8/25/03	4	6				-0.817 U		1.07
	3-SB-18-B-0-04 (6'-8')	8/25/03	6	8				1.15 U		1.15
	3-SB-18-B-0-05 (8'-10)	8/25/03	8	10	1.1 U	1.7	2.9	2.36	1.88	1.04
3-SB-19	3-SB-19-B-0-02 (2'-4)	8/25/03	2	4				5.58	2.85	1.17
	3-SB-19-B-0-03 (4'-6)	8/25/03	4	6	**31.5**	6.3	3.9	**39.3**	15.1	1.87
	3-SB-19-B-1-03 (5'-7)	8/25/03	5	7				0.885	1.01	0.599
	3-SB-19-B-0-04 (6'-8)	8/25/03	6	8				2.19 U		1.21
	3-SB-19-B-0-05 (8'-10)	8/25/03	8	10	0.6 U	3.7	6.5	-1.14 U		1.1
3-SB-20	3-SB-20-B-0-01 (0'-2')	8/22/03	0	2				2.32 U		1.08
	3-SB-20-B-0-02 (2'-4')	8/22/03	2	4				1.24 U		0.949
	3-SB-20-B-0-03 (4'-6')	8/22/03	4	6				0.482 U		0.882
	3-SB-20-B-0-04 (6'-8')	8/22/03	6	8	9.8	3.1	3.3	**37.7**	14.3	1.37
	3-SB-20-B-0-05 (8'-10')	8/22/03	8	10	2.7 U	3.5	5.7	0.688 U		0.983
3-SB-21	3-SB-21-B-0-01 (0'-2')	8/20/03	0	2				0.131 U		1.22
	3-SB-21-B-0-02 (2'-4')	8/20/03	2	4				1.13 U		0.893
	3-SB-21-B-0-03 (4'-6')	8/21/03	4	6	0.4 U	4.5	8	2.43 U		1.37
	3-SB-21-B-0-04 (6'-8')	8/21/03	6	8				0.39 U		1.35
	3-SB-21-B-0-05 (8'-10')	8/21/03	8	10	1.2 U	4.3	7.4	1.69 U		1.34
3-SB-22	3-SB-22-B-0-01	8/21/03	0	2	6.1	2.9	3.9			
	3-SB-22-B-0-01 (0'-2')	8/21/03	0	2				4.32	3.01	1.59
	3-SB-22-B-0-02 (2'-4')	8/21/03	2	4				0.0353 U		1.62
	3-SB-22-B-0-03 (4'-6')	8/21/03	4	6				1.58	1.4	0.799
	3-SB-22-B-0-04 (6'-8')	8/21/03	6	8				3.19 U		1.43
	3-SB-22-B-0-05 (8'-10')	8/21/03	8	10	2.9 U	2	3.3	1.31 U		1.48
3-SB-23	3-SB-23-B-0-01 (0'-2')	8/21/03	0	2	0.2 U	1.6	2.9	1.61 U		1.26

Table 5-3
Total Uranium Results for Soil Samples, AOC 3
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
					Uranium (Total)			Uranium (Total)		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
3-SB-23	3-SB-23-B-0-02 (2'-4')	8/21/03	2	4				-0.0419 U		1.44
	3-SB-23-B-0-03 (4'-6')	8/21/03	4	6				-0.00804 U		1.41
	3-SB-23-B-0-04 (6'-8')	8/21/03	6	8				1.33 U		1.16
	3-SB-23-B-0-05 (8'-10')	8/21/03	8	10	1.1 U	1.2	2	3.04 U		1.16
3-SB-24	3-SB-24-B-0-01 (0'-2')	8/21/03	0	2				2.08 U		1.52
	3-SB-24-B-1-01 (0'-2')	8/21/03	0	2				2.88 U		1.36
	3-SB-24-B-0-02 (2'-4')	8/21/03	2	4	2.5 U	2.5	3.9	1.77 U		1.11
	3-SB-24-B-1-02 (2'-4')	8/21/03	2	4				3.95 U		1.55
	3-SB-24-B-0-03 (4'-6')	8/21/03	4	6				6.44 U		1.64
	3-SB-24-B-1-03 (4'-6')	8/21/03	4	6				1.75 U		1.45
	3-SB-24-B-0-04 (6'-8')	8/21/03	6	8				3.25 U		1.47
	3-SB-24-B-1-04 (6'-8')	8/21/03	6	8				3.38 U		1.4
	3-SB-24-B-0-05 (8'-10')	8/21/03	8	10	-2.7 U	4.5	8.2	1.86	1.87	1.1
	3-SB-24-B-1-05 (8'-10')	8/21/03	8	10				3.9 U		1.4
3-SB-25	3-SB-25-B-0-01 (0'-2')	8/26/03	0	2				1.62 U		1.34
	3-SB-25-B-0-02 (2'-4')	8/26/03	2	4	**30.3**	6.5	4.7	**32.2**	12.3	1.45
	3-SB-25-B-0-03 (4'-6')	8/26/03	4	6				12.5	5.05	1.17
	3-SB-25-B-0-04 (6'-8')	8/26/03	6	8				0.942 U		0.676
	3-SB-25-B-0-05 (8'-10')	8/26/03	8	10	-1.6 U	4.5	8.2	-2.07 U		1.08
3-SB-26	3-SB-26-B-0-01 (0'-2')	8/26/03	0	2				1.41 U		1.13
	3-SB-26-B-1-01 (0'-2')	8/27/03	0	2				0.584 U		1.15
	3-SB-26-B-0-02 (2'-4')	8/26/03	2	4				2.49 U		1.03
	3-SB-26-B-1-02 (2'-4')	8/27/03	2	4				-0.793 U		1.07
	3-SB-26-B-0-03 (4'-6')	8/26/03	4	6				1.01	1.11	0.665
	3-SB-26-B-1-03 (4'-6')	8/27/03	4	6				-2.38 U		1.08
	3-SB-26-B-0-04 (6'-8')	8/26/03	6	8	**40.5**	8.8	6.5	**21.9**	8.74	1.77
	3-SB-26-B-1-04 (6'-8')	8/27/03	6	8				**21.7**	9.03	2.39
	3-SB-26-B-0-05 (8'-10')	8/26/03	8	10	-0.8 U	4.3	7.6	1.04	1.16	0.699
	3-SB-26-B-1-05 (8'-10')	8/27/03	8	10				3.09 U		1.38
3-SB-27	3-SB-27-B-0-01 (0'-2')	8/22/03	0	2				0.961	0.908	0.52
	3-SB-27-B-0-02 (2'-4')	8/22/03	2	4	1 U	2	3.5	2.61	1.55	0.722
	3-SB-27-B-0-03 (4'-6')	8/22/03	4	6				0.61 U		1.16
	3-SB-27-B-0-04 (6'-8')	8/22/03	6	8				1.47 U		1.04
	3-SB-27-B-0-05 (8'-10')	8/22/03	8	10	0.6 U	3.7	6.3	0.252 U		1.1
	3-SB-27-B-0-06 (10'-12')	8/22/03	10	12				0.252 U		0.809
	3-SB-27-B-0-07 (12'-14')	8/22/03	12	14				4.32 U		1.34
	3-SB-27-B-1-07 (12'-14')	8/22/03	12	14				0.992 U		1.42
	3-SB-27-B-0-08 (20'-22')	8/22/03	20	22				1.15	1.22	0.725

Table 5-3
Total Uranium Results for Soil Samples, AOC 3
(cont.)

					Offsite Alpha Spectroscopy		
					Uranium (Total)		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
3-SB-30	3-SB-30-SS-P-00	6/27/07	0	1	3.52	0.73	0.12
	3-SB-30-BS-P-05	6/27/07	5	6	1.88	0.43	0.08
3-SB-31	3-SB-31-SS-P-00	6/27/07	0	1	**22.9**	4	0.1
	3-SB-31-BS-P-05	6/27/07	5	6	1.28	0.32	0.13
3-SB-32	3-SB-32-SS-P-00	6/27/07	0	1	8.1	1.5	0.1
	3-SB-32-BS-P-04	6/27/07	4	5	2.44	0.55	0.07
3-SB-33	3-SB-33-SS-P-00	6/28/07	0	1	2.46	0.54	0.08
	3-SB-33-BS-P-01	6/28/07	1	2	0.63	0.2	0.06
3-SB-34	3-SB-34-SS-P-00	6/28/07	0	1	3.08	0.63	0.06
	3-SB-34-BS-P-04	6/28/07	4	5	2.08	0.47	0.07
3-SB-35	3-SB-35-SS-P-00	6/28/07	0	1	0.2	0.11	0.11
	3-SB-35-BS-P-04	6/28/07	4	5	3.22	0.68	0.09
3-SB-36	3-SB-36-SS-P-00	6/28/07	0	1	4.52	0.89	0.08
	3-SB-36-BS-P-05	6/28/07	5	6	**22.5**	3.8	0.1
3-SB-37	3-SB-37-SS-P-00	6/28/07	0	1	0.84	0.24	0.06
	3-SB-37-BS-P-06	6/28/07	6	7	**33.4**	5.9	0.1
3-SB-38	3-SB-38-SS-P-00	6/28/07	0	1	0.96	0.29	0.13
	3-SB-38-BS-P-07	6/28/07	7	8	0.56	0.19	0.07
3-SB-39	3-SB-39-SS-P-00	6/29/07	0	1	0.61	0.17	0.06
	3-SB-39-BS-P-04	6/29/07	4	5	**365** Y2,M3	63	1

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.
pCi/g = Picocuries per gram
TPU = Total Propagated Uncertainty
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits
Results in **bold** represent samples exceeding 14 pCi/g

Table 5-4
Radiological Isotopic Results for Soil Samples, AOC 3

					RA-226			Th-230			Th-234			U-234			U-235						U-238		
					Gamma Spec			Alpha Spec			Gamma Spec			Alpha Spec			Alpha Spec			Gamma Spec			Alpha Spec		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
3-MW-13B	3-MW-13-B-P-01	9/24/04	2	3									0.11	U	0.52	0.91									-0.04	U	0.17	0.32
	3-MW-13-B-P-02	9/24/04	6	7									0.53	U	0.9	1.5									-0.01	U	0.24	0.42
3-MW-14B	3-MW-14-B-P-01	9/23/04	2	3									0.2	U	1.1	1.8									-0.14	U	0.22	0.4
	3-MW-14-B-P-02	9/23/04	6	7									0.55	U	0.64	1.05									0.06	U	0.23	0.39
3-SB-01	3-SB-01-B-0-02	8/13/03	2	4	1.03		0.21	0.23					1.6	U	1.3	2									0.07	U	0.21	0.36
	3-SB-01-B-0-05	8/13/03	8	10	1.16		0.27	0.38					1.3	U	1.1	1.7									0.05	U	0.31	0.55
3-SB-02	3-SB-02-B-0-02	8/13/03	2	4					0.432	J	0.097	0.061																
	3-SB-02-B-0-05	8/13/03	8	10	1.17		0.22	0.19					0.54	U	0.84	1.4									0.09	U	0.36	0.61
3-SB-03	3-SB-03-B-0-02	8/12/03	2	4					1.07	J	0.2	0.06																
	3-SB-03-B-0-05	8/12/03	8	10	1.33		0.32	0.37					0.83	U	0.77	1.2									0.11	U	0.32	0.54
3-SB-04	3-SB-04-B-0-02	8/12/03	2	4					1.33	J	0.24	0.06																
	3-SB-04-B-0-05	8/12/03	8	10	0.44		0.19	0.33					2	U	2	3.2									0.32	U	0.33	0.52
3-SB-05	3-SB-05-B-0-02	8/11/03	2	4	0.39		0.16	0.32					8.4		2.8	3.5									0.44		0.2	0.34
	3-SB-05-B-0-05	8/11/03	8	10	0.78		0.2	0.3					-0.1	U	2	3.6									0.22	U	0.23	0.37
3-SB-06	3-SB-06-B-0-02	8/13/03	2	4	0.32	U	0.15	0.33					1.6	U	1.9	3.1									0.28	U	0.22	0.33
	3-SB-06-B-0-05	8/13/03	8	10	0.33		0.11	0.18					0.9	U	1.1	1.7									-0.09	U	0.27	0.49
3-SB-07	3-SB-07-B-0-03	8/14/03	4	6	1		0.26	0.35					0.15	U	0.86	1.5									-0.07	U	0.31	0.57
	3-SB-07-B-0-05	8/14/03	8	10	0.34		0.1	0.17					0.08	U	0.83	1.4									0.14	U	0.27	0.45
3-SB-08	3-SB-08-B-0-01	8/7/03	0	2					0.63		0.15	0.08																
	3-SB-08-B-0-03	8/7/03	4	6	0.9		0.25	0.35					0.4	U	2.2	3.8									0.23	U	0.26	0.41
	3-SB-08-B-0-05	8/7/03	8	10	1.33		0.33	0.36					1.9	U	2.1	3.4									0.17	U	0.22	0.36
3-SB-09	3-SB-09-B-0-01	8/8/03	0	2	0.67		0.2	0.35					7.2		2.1	2.5									0.21	U	0.19	0.3
	3-SB-09-B-0-02	8/8/03	2	4					1.21		0.23	0.07																
	3-SB-09-B-0-05	8/8/03	8	10	0.48		0.17	0.31					2.9	U	2.3	3.5									-0.05	U	0.23	0.42
3-SB-10	3-SB-10-B-0-01	8/11/03	0	2					0.48	J	0.12	0.08																
	3-SB-10-B-0-02	8/11/03	2	4	0.56		0.19	0.34					0.52	U	0.83	1.4									-0.02	U	0.27	0.5
	3-SB-10-B-0-05	8/11/03	8	10	1.05		0.26	0.37					0.17	U	0.97	1.7									0.03	U	0.33	0.56
3-SB-11	3-SB-11-B-0-02	8/14/03	2	4					1.2	J	0.24	0.08																
	3-SB-11-B-0-04	8/14/03	6	8	0.67		0.2	0.34					0.8	U	1.3	2.1									0.03	U	0.24	0.41
	3-SB-11-B-0-05	8/14/03	8	10	0.32		0.1	0.18					-0.07	U	0.73	1.3									-0.23	U	0.27	0.51
3-SB-12	3-SB-12-B-0-02	8/15/03	2	4	1.27		0.3	0.41					0.8	U	2.2	3.8									0.05	U	0.19	0.33
	3-SB-12-B-0-05	8/15/03	8	10	0.37		0.18	0.33					-1.4	U	2	3.6									0.11	U	0.18	0.29
3-SB-13	3-SB-13-B-0-04	8/19/03	6	8	0.82		0.24	0.35					1	U	2.1	3.6									-0.05	U	0.25	0.45
	3-SB-13-B-0-05	8/19/03	8	10	0.83		0.24	0.42					-0.3	U	2.1	3.7									0.25	U	0.23	0.36
3-SB-14	3-SB-14-B-0-03	8/18/03	4	6	0.97		0.25	0.41					1.4	U	1.3	2.1									0.03	U	0.4	0.69
	3-SB-14-B-0-05	8/18/03	8	10	0.32		0.17	0.31					0.8	U	2.2	3.8									-0.03	U	0.15	0.28
3-SB-15	3-SB-15-B-0-04	8/20/03	6	8	0.67		0.17	0.28					0.8	U	2.1	3.5									0.22	U	0.18	0.29
	3-SB-15-B-0-05	8/20/03	8	10	0.29		0.11	0.18					0.28	U	0.64	1.1									0.27	U	0.26	0.4
3-SB-16	3-SB-16-B-0-04	8/19/03	6	8	1.37		0.31	0.36					-0.8	U	2.1	3.6									-0.01	U	0.21	0.37
	3-SB-16-B-0-05	8/19/03	8	10	0.4		0.11	0.18					0.6	U	1	1.7									0.17	U	0.32	0.53
3-SB-17	3-SB-17-B-0-02	8/22/03	2	4					0.57	J	0.14	0.08																
	3-SB-17-B-0-03	8/22/03	4	6	1.34		0.32	0.4					2.7		1.2	1.7									0.25	U	0.31	0.5
	3-SB-17-B-0-05	8/22/03	8	10	0.43		0.14	0.24					-0.3	U	1.6	2.9									-0.15	U	0.29	0.53
3-SB-18	3-SB-18-B-0-02	8/25/03	2	4	0.38		0.13	0.26					0.6	U	1	1.7									0.13	U	0.29	0.49
	3-SB-18-B-0-03	8/25/03	4	6					0.171	J	0.059	0.066																
	3-SB-18-B-0-05	8/25/03	8	10	0.35		0.1	0.15					0.54	U	0.82	1.4									0.03	U	0.27	0.47
3-SB-19	3-SB-19-B-0-03	8/25/03	4	6	0.37	U	0.25	0.47					15.4		3.1	1.9									1		0.36	0.47
	3-SB-19-B-0-05	8/25/03	8	10	0.36		0.13	0.26					0.3	U	1.8	3.2									-0.13	U	0.3	0.54
3-SB-20	3-SB-20-B-0-01	8/22/03	0	2					0.47	J	0.11	0.07																
	3-SB-20-B-0-04	8/22/03	6	8	1.18		0.26	0.3					4.8		1.5	1.6									0.28	U	0.29	0.45
	3-SB-20-B-0-05	8/22/03	8	10	0.57		0.17	0.29					1.3	U	1.7	2.8									-0.03	U	0.2	0.37

Table 5-4
Radiological Isotopic Results for Soil Samples, AOC 3
(cont.)

					RA-226			Th-230			Th-234			U-234			U-235						U-238		
					Gamma Spec			Alpha Spec			Gamma Spec			Alpha Spec			Alpha Spec			Gamma Spec			Alpha Spec		
LocCode	ClientSampleID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
3-SB-21	3-SB-21-B-0-02	8/21/03	2	4					0.392	J	0.095	0.07																
	3-SB-21-B-0-03	8/21/03	4	6	0.81		0.21	0.32					0.2	U	2.2	3.9												
	3-SB-21-B-0-05	8/21/03	8	10	1.2		0.28	0.39					0.6	U	2.1	3.6												
3-SB-22	3-SB-22-B-0-01	8/21/03	0	2	0.97		0.24	0.38					3		1.4	1.9												
	3-SB-22-B-0-02	8/21/03	2	4					0.49	J	0.12	0.08																
	3-SB-22-B-0-05	8/21/03	8	10	1.23		0.27	0.35					1.4	U	1	1.6												
3-SB-23	3-SB-23-B-0-01	8/21/03	0	2	0.3	U	0.19	0.39					0.1	U	0.79	1.4												
	3-SB-23-B-0-02	8/21/03	2	4					0.77	J	0.17	0.09																
	3-SB-23-B-0-05	8/21/03	8	10	0.49		0.14	0.25					0.55	U	0.6	0.98												
3-SB-24	3-SB-24-B-0-02	8/21/03	2	4	0.99		0.28	0.45					1.2	U	1.2	1.9												
	3-SB-24-B-0-03	8/21/03	4	6					0.67	J	0.16	0.08																
	3-SB-24-B-0-05	8/21/03	8	10	1.12		0.21	0.17					-1.3	U	2.2	4												
3-SB-25	3-SB-25-B-0-02	8/26/03	2	4	0.59		0.2	0.33					14.8		3.2	2.3												
	3-SB-25-B-0-03	8/26/03	4	6					1.31	J	0.27	0.09																
	3-SB-25-B-0-05	8/26/03	8	10	0.55		0.17	0.33					-0.8	U	2.2	4												
3-SB-26	3-SB-26-B-0-02	8/26/03	2	4					0.61	J	0.15	0.1																
	3-SB-26-B-0-04	8/26/03	6	8	1.45	J	0.47	1					19.8		4.3	3.2												
	3-SB-26-B-0-05	8/26/03	8	10	0.38		0.17	0.35					-0.4	U	2.1	3.7												
3-SB-27	3-SB-27-B-0-02	8/22/03	2	4	0.71		0.23	0.42					0.49	U	1	1.7												
	3-SB-27-B-0-03	8/22/03	4	6					0.7	J	0.15	0.07																
	3-SB-27-B-0-05	8/22/03	8	10	0.71		0.2	0.33					0.3	U	1.8	3.1												
3-SB-30	3-SB-30-SS-P-00	6/27/07	0	1	0.44	LT	0.15	0.29	0.53		0.11	0.06	-2.7	U,M	3.3	6.3	1.67		0.35	0.06	0.07	LT	0.051	0.055	0.04	U	0.27	0.48	1.72		0.36	0.06
	3-SB-30-BS-P-05	6/27/07	5	6	0.59		0.18	0.34	0.446		0.093	0.049	U,M		3.2	5.7	0.87		0.2	0.02	0.045	LT	0.038	0.044	0.08	U	0.33	0.57	0.92		0.21	0.04
3-SB-31	3-SB-31-SS-P-00	6/27/07	0	1	1.37	G	0.3	0.39	0.95		0.18	0.05	8.8	G	2.4	2.9	10.8		1.9	0.1	0.66		0.18	0.04	0.72	LT,G,TI	0.47	0.7	11.2		1.9	
	3-SB-31-BS-P-05	6/27/07	5	6	0.8	G	0.21	0.38	0.62		0.12	0.05	0.9	U,G	1.1	1.8	0.56		0.14	0.06	0.028	U	0.029	0.039	0.18	U,G	0.29	0.48	0.62		0.15	0.06
3-SB-32	3-SB-32-SS-P-00	6/27/07	0	1	1.05	G	0.25	0.4	1.03		0.19	0.06	6.3	U,M,G	5.2	8.2	3.92		0.7	0.04	0.222		0.085	0.035	-0.08	U,G	0.36	0.65	3.98		0.71	0.04
	3-SB-32-BS-P-04	6/27/07	4	5	1.65	G	0.32	0.42	1.21		0.22	0.06	1.9	LT,G	1.2	1.9	1.44		0.31	0.05	0.088	LT	0.055	0.022	0.2	U,G	0.38	0.64	1.19		0.27	0.04
3-SB-33	3-SB-33-SS-P-00	6/28/07	0	1	0.42	LT	0.14	0.29	0.41		0.11	0.08	-0.4	U,M	3.2	5.8	1.2		0.26	0.05	0.02	U	0.027	0.039	0.07	U	0.25	0.43	1.2		0.26	0.04
	3-SB-33-BS-P-01	6/28/07	1	2	0.35	LT	0.14	0.32	0.425		0.098	0.059	0.1	U	1.1	1.9	0.38		0.11	0.04	0.034	U	0.034	0.047	-0.27	U	0.25	0.49	0.308		0.097	0.03
3-SB-34	3-SB-34-SS-P-00	6/28/07	0	1	0.83	G	0.23	0.36	0.58		0.13	0.07	-0.1	U,M,G	4.5	8	1.47		0.3	0.05	0.078	LT	0.048	0.035	0.19	U,G	0.38	0.64	1.5		0.31	0.03
	3-SB-34-BS-P-04	6/28/07	4	5	0.72	G	0.21	0.35	0.56		0.12	0.06	3	U,M,G	4.1	6.7	0.97		0.22	0.05	0.064	LT	0.044	0.019	0.12	U,G	0.37	0.64	1.02		0.23	0.03
3-SB-35	3-SB-35-SS-P-00	6/28/07	0	1	1.21	G	0.26	0.38	0.52		0.12	0.06	-0.4	U,G	1	2	0.115		0.054	0.041	0.025	LT	0.025	0.017	-0.05	U,G	0.3	0.56	0.098	LT	0.052	0.052
	3-SB-35-BS-P-04	6/28/07	4	5	0.87	M3,G	0.26	0.5	0.99		0.19	0.06	1.3	U,M,G	5.7	9.8	1.65		0.34	0.04	0.071	LT	0.049	0.021	-0.06	U,G	0.46	0.83	1.57		0.33	0.04
3-SB-36	3-SB-36-SS-P-00	6/28/07	0	1	0.5	LT	0.19	0.37	0.347		0.078	0.049	4.1	U,M	3.4	5.4	2.03		0.4	0.05	0.125		0.065	0.039	-0.12	U	0.32	0.59	2.21		0.43	0.04
	3-SB-36-BS-P-05	6/28/07	5	6	1.92	M3,G	0.35	0.51	6.6		1.1	0.1	11.9	G	2.6	2.6	10.6		1.8		0.59		0.16	0.04	1.03	LT,G	0.46	0.77	11		1.9	
3-SB-37	3-SB-37-SS-P-00	6/28/07	0	1	0.49	LT	0.16	0.31	0.347		0.081	0.053	-1.7	U,M	3.3	6.2	0.38		0.11	0.04	0.049	U	0.04	0.049	-0.06	U	0.27	0.5	0.41		0.12	0.03
	3-SB-37-BS-P-06	6/28/07	6	7	3.83	M3,G	0.59	0.58	11.1		1.8	0.1	14.3	M3,G	9.1	13.9	16.4		2.9	0.1	0.91		0.25	0.06	1.68	LT,G	0.71	1.1	16.3		2.9	
3-SB-38	3-SB-38-SS-P-00	6/28/07	0	1	0.51	G	0.17	0.31	0.355		0.078	0.048	0.5	U,M,G	3.3	5.7	0.53		0.15	0.06	0.022	U	0.03	0.043	0.04	U,G	0.33	0.58	0.47		0.14	0.06
	3-SB-38-BS-P-07	6/28/07	7	8	0.52	TI	0.2	0.32	0.328		0.083	0.061	0.5	U	1.2	2.1	0.269		0.091	0.045	0.005	U	0.024	0.053	-0.04	U	0.26	0.48	0.273		0.091	0.036
3-SB-39	3-SB-39-SS-P-00	7/5/07	0	1	0.48	LT	0.17	0.32	0.304		0.078	0.06	-2.1	U,M	3.7	6.9	0.339		0.093	0.034	0.028	U	0.025	0.032	-0.17	U	0.25	0.49	0.299		0.085	0.03
	3-SB-39-BS-P-04	7/5/07	4	5	1.51	G	0.3	0.46	10.9	M3	1.9	0.2	138	M3,G	20	12	169	Y2,M3	29		9.5	Y2,M3	1.9	0.3	8.1	G	1.2	1.2	178	Y2,M3	31	

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
pCi/g = Picocuries per gram
TPU = Total Propagated Uncertainty

G = Sample density differs by more than 15% of LCS density: sample results may be biased
J = Estimated result
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met

M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.
TI = Nuclide identification is tentative
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits

Table 5-5
Metals Exceeding Preliminary Remediation Goals in Soil Samples, AOC 3

			Analyte	ANTIMONY	ARSENIC	CHROMIUM	LEAD	MERCURY
			NJDEP SCC (mg/kg)	14	20	NA	400	14
			Region 6 PRG (mg/kg)	**31.3**	**0.39**	**30.1**	**400**	**6.11**
Sample ID	**Sample Date**	**Start Depth/ End Depth (ft bgs)**		**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**
3-SB-30-BS-P-05	**6/27/07**	**5 / 6**			1.4			
3-SB-30-SS-P-00	**6/27/07**	**0 / 1**			25	35	1200	
3-SB-31-BS-P-05	**6/27/07**	**5 / 6**			2.6			
3-SB-31-SS-P-00	**6/27/07**	**0 / 1**			5.5		3700	
3-SB-32-BS-P-04	**6/27/07**	**4 / 5**			2.7			
3-SB-32-SS-P-00	**6/27/07**	**0 / 1**			14	36	430	
3-SB-33-BS-P-01	**6/28/07**	**1 / 2**			2.3		2300	
3-SB-33-SS-P-00	**6/28/07**	**0 / 1**			3.9		820	
3-SB-34-BS-P-04	**6/28/07**	**4 / 5**			2.7			
3-SB-34-SS-P-00	**6/28/07**	**0 / 1**			3.6			
3-SB-35-BS-P-04	**6/28/07**	**4 / 5**			2.5			
3-SB-35-SS-P-00	**6/28/07**	**0 / 1**			2.2			
3-SB-36-BS-P-05	**6/28/07**	**5 / 6**		32	23	140	54000	7.9
3-SB-36-SS-P-00	**6/28/07**	**0 / 1**			2.1			
3-SB-37-BS-P-06	**6/28/07**	**6 / 7**		170	16	130	9600	14
3-SB-37-SS-P-00	**6/28/07**	**0 / 1**			1.4			
3-SB-38-SS-P-00	**6/28/07**	**0 / 1**			1.3			
3-SB-39-BS-P-04	**7/5/07**	**4 / 5**			6.7	59		

Notes:

ft bgs = Feet below ground surface
mg/kg = Milligrams per kilogram
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria

Table 5-6
VOCs and SVOCs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 3

		Sample ID	3-SB-30-SS-P-00		3-SB-31-SS-P-00		3-SB-32-SS-P-00		3-SB-34-BS-P-04		3-SB-34-SS-P-00		3-SB-35-BS-P-04		3-SB-35-SS-P-00		3-SB-36-BS-P-05	
		Sample Date	6/27/07		6/27/07		6/27/07		6/28/07		6/28/07		6/28/07		6/28/07		6/28/07	
		StartDepth / EndDepth (ft)	0 / 1		0 / 1		0 / 1		4 / 5		0 / 1		4 / 5		0 / 1		5 / 6	
	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
VOCS																		
HEXACHLOROBENZENE	660	**304**															390	J
SVOC																		
BENZENE	3000	**656**															3600	

Notes:

ft bgs = Feet below ground surface
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
ug/kg = Micrograms per kilogram
J = Result is an estimated value

Table 5-7
PAHs and PCBs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 3

Sample ID			3-SB-30-SS-P-00		3-SB-31-SS-P-00		3-SB-32-BS-P-04		3-SB-32-SS-P-00		3-SB-33-BS-P-01		3-SB-33-SS-P-00		3-SB-34-BS-P-04	
StartDepth / EndDepth (ft bgs)			0 / 1		0 / 1		4 / 5		0 / 1		1 / 2		0 / 1		4 / 5	
	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
PAH																
BENZO(A)ANTHRACENE	**900**	**148**			370	B			2200	B					280	B
BENZO(A)PYRENE	660	**14.8**	86		390		21		1800		35		17		180	
BENZO(B)FLUORANTHENE	900	**148**	230		600				2800						280	
DIBENZO(A,H)ANTHRACENE	660	**14.8**	17		62				230						25	
INDENO(1,2,3-CD)PYRENE	900	**148**			150				600							
PCB																
AROCLOR-1260	NA	**222**							11000							

Sample ID			3-SB-34-SS-P-00		3-SB-35-BS-P-04		3-SB-35-SS-P-00		3-SB-36-BS-P-05		3-SB-36-SS-P-00		3-SB-37-BS-P-06	
StartDepth / EndDepth (ft bgs)			0 / 1		4 / 5		0 / 1		5 / 6		0 / 1		6 / 7	
	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
PAH														
BENZO(A)ANTHRACENE	**900**	**148**			1200	B	200	B	700	B				
BENZO(A)PYRENE	660	**14.8**	180		950		210		570		55		23	
BENZO(B)FLUORANTHENE	900	**148**	270		1400		570		1000					
DIBENZO(A,H)ANTHRACENE	660	**14.8**	27		180		45		99					
INDENO(1,2,3-CD)PYRENE	900	**148**			470				260					
PCB														
AROCLOR-1260	NA	**222**	1900				8800		270					

Notes:

ft bgs = Feet below ground surface
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
ug/kg = Micrograms per kilogram
ft = Feet
B = Analyte is detected in blank

Table 5-8
YSI Water Quality Data, AOC 3

Boring Location	pH	Conductivity µS/cm	Conductivity µS/cm	Temperature [°C]	ORP [mV]	Turbidity [NTU]	Dissolved Oxygen [mg/L]
3-SB-01	6.7	0.95	950	18.6	219	[-]	[-]
3-SB-02	7.6	0.53	530	21.9	190	35.7	1.92
3-SB-03	7	0.47	470	19.7	177	42.4	3.85
3-SB-04	7.9	0.97	970	20.2	168	25.5	4.74
3-SB-05	7.3	0.79	790	21.7	120	3.86	6.94
3-SB-06	6.7	1.68	1680	22.4	127	1	5.18
3-SB-07	7.3	3.65	3650	19.7	219	248	8.71
3-SB-08	7.1	1	1000	21.6	87.4	14.6	4.1
3-SB-09	5.8	1.44	1440	21.5	90.7	592	1.7
3-SB-10	6.9	1.32	1320	22.4	176	74.3	3.9
3-SB-11	5.3	1.88	1880	20.6	227	73.4	2.96
3-SB-12	5.6	1.44	1440	20.8	220	501	1.76
3-SB-13	6.4	2.93	2930	19.2	201	99.9	3.96
3-SB-14	6.2	8.26	8260	22	202	7	[-]
3-SB-15	4.9	3.34	3340	19.6	183	[-]	0.41
3-SB-17	5.7	4.01	4010	23.7	234	99.9	0.68
3-SB-19	6.4	2.42	2420	23	228	99.9	6.79
3-SB-20	7.6	1.26	1260	22	173	99.9	7.29
3-SB-24	7.9	1.68	1680	20.1	154	567	[-]
3-SB-25	6.6	4.21	4210	19.9	3.3	207	9.9
3-SB-27	6.6	4.52	4520	25.5	162	99.9	5.32
AVERAGE	**6.6**	**2.3**	**2321**	**21.2**	**169.6**	**152**	**4.5**

Notes:

ºC = Degrees Celsius
mS/cm^{3} = Micro Siemens per cubic centimeters
NTU = Nephelometric Turbidity Unit
mV = Millivolts
mg/L = Milligrams per Liter
[-] = No data available

Table 5-9
HACH Kit Water Quality Data, AOC 3

Piezometer Location	Fe^{2+} (mg/L)		NO^{2-} (mg/L)		S_2 (mg/L)		SO_4 (mg/L)	
	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
3-SB-01	2.96	1.51	0	0	0.005	0	11	0
3-SB-02	2.9	2.76	0	0	0.001	0.074	0	0
3-SB-03	2.1	0.53	0.017	0	0.006	0.018	14	13
3-SB-04	0.01	1	0.045	0.026	0	0.055	25	28
3-SB-05	0.91	1.1	0	0.003	0.011	0.012	32	31
3-SB-06	1.14	0.64	0.014	0	0.01	0.286	17	6
3-SB-07	0.41	1.05	0.026	0.029	0.029	0.143	64	53
3-SB-08	1.21	2.85	0.019	-0.047	0.318	0.135	1	1
3-SB-09	0.89	0.97	0	0	0.213	0.436	5	14
3-SB-10	1.49	1.71	0	0.054	0.069	0.112	1	15
3-SB-11	2.2	2.13	0.004	0.002	0.305	0.486	10	14
3-SB-12	1.56	1.58	0	0	0.626	0.145	1	2
3-SB-13	2.22	2.46	0	0.025	0.211	0.225	34	34
3-SB-14	2.84	2.77	0		0.012	0.007	24	24
3-SB-15	1.93	1.31	0.025	0.009	0.008	0.05	29	24
3-SB-17	1.39	1.16	0.003	0	0.013	0.138	21	20
3-SB-19	0.81	1.02	0	0	0.003	0.086	9	11
3-SB-20	0.13	0.1	0.016	0.004	0.012	0.146	49	39
3-SB-24	0.19	0.39	0		0.001	0.33	0	0
3-SB-25	1.66	1.81	0	0	0.004	0.065	20	21
3-SB-27	1.83	1.98	0	0	0.024	0.073	13	15
AVERAGE	**1.47**	**1.47**	**0.01**	**0.01**	**0.09**	**0.14**	**18**	**17**

Notes:

mg/L = Milligrams per Liter

Table 5-10
Major Ions in Groundwater, AOC 3

	Chloride (mg/L)		Nitrate-N (mg/L)		Orthophosphate as P (mg/L)		Total Alkalinity as CaCO3 (mg/L)	
NJDEP WQC	250		10		NA		NA	
Region 6 PRG	**NA**		**10**		**NA**		**NA**	
	Filtered	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**
Sample Location	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**
3-SB-01	150 J	150 J	0.2 U	0.2 U	0.4 U	0.4 U	190	190
3-SB-04	180 J	180 J	0.4 U	0.4 U	0.2 U	0.2 U	220 J	230 J
3-SB-05	29 J	26 J	0.2 U	0.2 U	0.05 U	0.05 U	140 J	130 J
3-SB-06	370 J	330 J	0.4 U	0.4 U	0.05 U	0.05 U	110 J	170 J
3-SB-07	470 J	470 J	0.4 U	0.4 U	0.4 U	0.4 U	310	310
3-SB-08	360 J	350 J	0.05 U	0.05 U	0.05 U	0.05 U	170 J	150 J
3-SB-8	500 J	470 J	0.4 U	0.4 U	0.4 U	0.46 J	300 J	300 J
3-SB-09	140 J	140 J	0.01 U	0.15	0.05 U	0.05 U	220 J	190
3-SB-11	270 J	270 J	0.4 U	0.4 U	0.4 UJ	0.41 J	170 J	170 J
3-SB-12	160 J	150 J	0.2 U	0.25	0.2 UJ	0.2 UJ	190 J	170 J
3-SB-13	470 J	480 J	0.4 U	0.4 U	0.4 UJ	0.4 UJ	170 J	170 J
3-SB-14	290 J	1500 J	1 U	2 U	1 UJ	2.5 J	71 J	160 J
3-SB-15	270 J	350 J	1 U	1 U	0.05 U	0.05 U	40 J	23 J
3-SB-17	910 J	910 J	1 U	1 U	0.05 U	0.05 U	150 J	130 J
3-SB-19	570 J	350 J	1 U	1 U	0.05 U	0.05 U	320 J	200 J
3-SB-20	620 J	130 J	1 U	2.3	0.05 U	0.15 J	300 J	310 J
3-SB-24	260 J	190 J	0.4 UJ	0.4 U	0.05 U	0.05 U	380 J	440 J
3-SB-25	150 J	150 J	1 U	1 U	0.05 U	0.05 U	270 J	270 J
3-SB-27	790 J	750 J	1 U	1	0.05 U	0.05 U	260 J	260 J
AVERAGE	**366**	**387**	**0.55**	**0.68**	**0.21**	**0.30**	**210**	**209**

Notes:

mg/L = Milligrams per Liter

NA = Not available

PRG = Preliminary Remediation Goal

WQC = Water Quality Criteria

U = Result is less than the sample specific MDC

J = Result is an estimate value

Table 5-11
Isotopic and Total Uranium in Groundwater, AOC 3

		U-234				U-235				U-238				Uranium (Total)					
		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered			Unfiltered		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
3-SB-01-G-0-01	8/13/03	0.82	0.24	26.7	3.7	0.1 U	0.092	2.02	0.47	0.89	0.25	27.3	3.8	1.82	2.73	0.51	55.8	83.7	7.8
3-SB-02-G-0-01	8/13/03	1.85	0.34	1.05	0.23	0.125	0.072	0.087	0.058	1.78	0.33	1.02	0.22	3.64	5.46	0.67	2.09	3.13	0.45
3-SB-03-G-0-01	8/12/03	0.71	0.18	0.44	0.14	0.037 U	0.042	0.065	0.052	0.62	0.17	0.54	0.16	1.27	1.90	0.35	1.1	1.6	0.33
3-SB-04-G-0-01	8/12/03	0.045 U	0.059	0.19 J	0.10	0.077 U	0.075	0.028 U	0.057	0.066 U	0.064	0.124 J	0.083	0.13	0.19 U	0.13	0.25	0.37 J	0.17
3-SB-05-G-0-01	8/11/03	3.37	0.61	4.15	0.71	0.26	0.13	0.27	0.13	3.61	0.64	3.74	0.65	7.4	11.1	1.3	7.6	11.4	1.3
3-SB-06-G-0-01	8/13/03	0.9	0.25	1.64	0.37	0.044 U	0.058	0.096 U	0.089	1	0.27	1.81	0.39	2.04	3.06	0.55	3.7	5.5	0.80
3-SB-07-G-0-01	8/14/03	0.162	0.099	0.54	0.18	-0.014 U	0.054	0.092	0.079	0.144	0.091	0.34	0.14	0.29	0.43	0.18	0.7	1.0	0.29
3-SB-08-G-0-01	8/7/03	0.21 J	0.11	0.84 J	0.25	0.038 U	0.057	0.084 U	0.080	0.093 U	0.078	0.76 J	0.23	0.19	0.28 U	0.16	1.55	2.32 J	0.47
3-SB-8-G-0-01	9/3/03	0.061 U	0.067	1.81 J	0.37	0.01 U	0.051	0.2 J	0.11	0.001 U	0.044	1.7 J	0.36	0.002	0.003 U	0.090	3.48	5.22 J	0.74
3-SB-09-G-0-01	8/8/03	0.093 J	0.074	0.2	0.11	0.016 U	0.058	0.028 U	0.058	0.028 U	0.050	0.098 U	0.079	0.06	0.09 U	0.10	0.2	0.3 U	0.16
3-SB-10-G-0-01	8/11/03	0.033 U	0.055	0.52	0.15	0.026 U	0.039	0.055 U	0.050	0.12	0.070	0.38	0.12	0.25	0.37	0.14	0.78	1.17	0.25
3-SB-11-G-0-01	8/14/03	0.142 J	0.089	0.26 J	0.12	0.062 U	0.061	0.122 J	0.090	0.041 U	0.047	0.138 U	0.096	0.084	0.126 U	0.096	0.28	0.42 U	0.20
3-SB-12-G-0-01	8/15/03	0.58 J	0.21	0.93 J	0.25	0.13 J	0.11	0.091 U	0.080	0.34 J	0.16	0.79 J	0.22	0.7	1.05 J	0.33	1.62	2.43 J	0.45
3-SB-13-G-0-01	8/19/03	0.161 J	0.099	0.42 J	0.15	0.036 U	0.052	0.03 U	0.051	0.26 J	0.12	0.35 J	0.14	0.53	0.79 J	0.25	0.72	1.08 J	0.29
3-SB-14-G-0-01	8/18/03	2.24 J	0.43	197 J	27	0.094 U	0.081	10.3 J	2.9	2.53 J	0.47	196 J	27	5.17	7.75 J	0.96	401	601 J	55
3-SB-15-G-0-01	8/20/03	1.71 J	0.61	3.42 J	0.92	0.3 J	0.25	0.54 J	0.33	1.71 J	0.62	3.08 J	0.85	3.5	5.2 J	1.3	6.3	9.4 J	1.7
3-SB-17-G-0-01	8/22/03	0.41	0.19	3.98	0.77	0.04 U	0.083	0.23	0.14	0.5	0.21	3.75	0.73	1.02	1.53	0.43	7.7	11.5	1.5
3-SB-19-G-0-01	8/25/03	0.93 J	0.29	0.49 J	0.26	0.103 U	0.098	0.02 U	0.12	1 J	0.30	0.6 J	0.28	2.04	3.06 J	0.61	1.23	1.84 J	0.57
3-SB-20-G-0-01	8/22/03	0.32	0.14	6.4	1.0	0 U	0.057	0.33	0.16	0.31 U	0.13	6.4	1.0	0.63	0.94 U	0.27	13.1	19.6	2.0
3-SB-24-G-0-01	8/21/03	0.88	0.25	1.33	0.33	0.017 U	0.060	0.081 U	0.077	0.69	0.22	1.35	0.33	1.41	2.11	0.45	2.76	4.14	0.67
3-SB-25-G-0-01	8/26/03	0.129 U	0.099	0.18 J	0.10	-0.003 U	0.058	0.018 U	0.058	0.117 J	0.084	0.17 J	0.11	0.24	0.36 J	0.17	0.35	0.52 J	0.22
3-SB-27-G-0-01	8/22/03	0.075 U	0.068	1.39	0.34	0.077 U	0.073	0.15	0.11	0.121	0.083	1.17	0.31	0.25	0.37	0.17	2.39	3.58	0.63
3-SB-30-GU-P-12	6/27/07	NS	NS	0.077 U	0.078	NS	NS	0.039 U	0.053	NS	NS	0.13 LT	0.093	NS	NS	NS	0.27	0.40 LT	0.19
3-SB-32-GU-P-12	6/27/07	NS	NS	0.34	0.14	NS	NS	0 U	0.048	NS	NS	0.22	0.11	NS	NS	NS	0.46	0.69	0.23
3-SB-34-GU-P-12	6/28/07	NS	NS	0.137 LT	0.09	NS	NS	0.052 U	0.057	NS	NS	0.127 LT	0.081	NS	NS	NS	0.26	0.39 LT	0.17
3-SB-35-GU-P-12	6/28/07	NS	NS	0.171 LT	0.094	NS	NS	0.05 U	0.054	NS	NS	0.154 LT	0.087	NS	NS	NS	0.31	0.46 LT	0.18
3-SB-36-GU-P-12	6/28/07	NS	NS	0.37	0.15	NS	NS	0.06 U	0.068	NS	NS	0.31	0.14	NS	NS	NS	0.63	0.94	0.29
3-SB-37-GU-P-12	6/28/07	NS	NS	0.164 LT	0.097	NS	NS	0.017 U	0.055	NS	NS	0.112 LT	0.08	NS	NS	NS	0.23	0.34 LT	0.16
3-SB-38-GU-P-10	6/28/07	NS	NS	0.027 U	0.04	NS	NS	-0.003 U	0.04	NS	NS	0.027 U	0.04	NS	NS	NS	0.054	0.081 U	0.081
3-SB-39-GU-P-12	6/29/07	NS	NS	10.8	2	NS	NS	0.59	0.23	NS	NS	12.1	2.2	NS	NS	NS	24.7	37.0	4.5
AVERAGE		**0.72**		**9.14**		**0.06**		**0.53**		**0.53**		**9.28**		**1.48**	**1.62**		**18.05**	**27.07**	

Notes:

pCi/L = Picocuries per Liter
NS = Not Sampled
TPU = Total Propagated Uncertainty
ug/L = Micrograms per Liter

J = Result is an estimated value
LT = Result is less than requested MDC but graeater than sample specific MDC
U = Result is less than the sample specific MDC
Shading indicates results above MCL of 30 ug/L total uranium

pCi/L results are converted to ug/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 5-12
Radiochemical Analysis of Groundwater, AOC 3

		GROSS ALPHA				GROSS BETA				RA-226				RA-228				Th-228		Th-230		Th-232	
MCL (pCi/L)		15				NA				5 (RA-226/288 combined)				5 (RA-226/288 combined)				NA		NA		NA	
		Filtered				Filtered				Filtered				Filtered				Unfiltered		Unfiltered		Unfiltered	
Sample ID	Sample Date	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]	Result (pCi/L)	Flag	TPU [+/- 2σ]
3-SB-01-G-0-01	8/13/03	1.75		0.82	72	13	1.8 U		1.2	102	17	0.4	0.2	5	1.4	0.44 U	0.52	2.2 J	1	NS	NS	NS	NS	NS	NS
3-SB-02-G-0-01	8/13/03	2.4		1.3	1.6 U	1.2	10.2		2.4	8.5	2.4	0.4 J	0.2	0.35 U	0.27	1.25 J	0.62	0.77 U	0.59	NS	NS	NS	NS	NS	NS
3-SB-03-G-0-01	8/12/03	1.7 U		1.1	1.49	0.89	6.5		1.8	7	1.9	0.022 U	0.095	0.38 U	0.27	0.6 U	0.58	0.64 U	0.56	NS	NS	NS	NS	NS	NS
3-SB-04-G-0-01	8/12/03	0.5 U		1	1.1 U	1	2.4 U		1.8	3.3 J	1.6	0.008 U	0.081	0.31 J	0.17	0.18 U	0.41	1.22 J	0.63	NS	NS	NS	NS	NS	NS
3-SB-05-G-0-01	8/11/03	5.2 J		1.6	6.1 J	1.8	6.4 J		1.8	6.2 J	1.7	0.06 U	0.11	0.14 U	0.13	0.56 U	0.47	0.36 U	0.42	NS	NS	NS	NS	NS	NS
3-SB-06-G-0-01	8/13/03	1.1 U		1	7.3 J	1.9	9.4 J		2.5	12.2 J	3.1	0.32 U	0.24	1.3 J	0.57	0.88 J	0.49	0.72 U	0.47	NS	NS	NS	NS	NS	NS
3-SB-07-G-0-01	8/14/03	1.1 U		2.1	6.6	2.6	12.8		3.8	19.2	4.7	0.76	0.28	2.84	0.75	0.71 U	0.6	0.98 U	0.65	NS	NS	NS	NS	NS	NS
3-SB-08-G-0-01	8/7/03	1 U		1.1	8.5 J	2.4	7.1 J		1.9	17.6 J	3.9	0.29 J	0.13	0.19 U	0.32	0.33 U	0.4	0.69 U	0.48	NS	NS	NS	NS	NS	NS
3-SB-8-G-0-01	9/2/03	0.4 U		1.3	**25.5** J	5.9	22.8 J		4.3	51.3 J	9.5	0.51 J	0.22	2.56 J	0.68	1.38 J	0.67	5.6 U	9.7	NS	NS	NS	NS	NS	NS
3-SB-09-G-0-01	8/8/03	0.3 U		1	3 J	1.1	8.6 J		2.4	13.4 J	2.7	0.056 U	0.069	0.44 J	0.26	0.14 U	0.41	0.26 U	0.46	NS	NS	NS	NS	NS	NS
3-SB-10-G-0-01	8/11/03	0.4 U		1.1	2.6	1.1	10.9		2.5	12.7	2.9	0.38 J	0.18	1.21 J	0.5	0.45 U	0.51	0.2 U	0.5	NS	NS	NS	NS	NS	NS
3-SB-11-G-0-01	8/14/03	2.2 J		1.2	2.4 J	1	7.4 J		2	5.1 J	1.7	0.43	0.2	0.1 U	0.19	1.14 J	0.67	0.55 U	0.59	NS	NS	NS	NS	NS	NS
3-SB-12-G-0-01	8/15/03	1.71 J		0.7	**16.3** J	3.5	9.9 J		2.1	30.1 J	5.7	0.19 U	0.15	3.6	1	1.26 J	0.64	1.4 J	0.76	NS	NS	NS	NS	NS	NS
3-SB-13-G-0-01	8/19/03	**18.8**		3.8	**32.3**	6	5.2		2.6	19.2	4.3	1.28 J	0.4	2.4 J	0.83	3.2 J	1.1	2.16 J	0.87	NS	NS	NS	NS	NS	NS
3-SB-14-G-0-01	8/18/03	14 J		7.5	29.6 J	9.1	-5 U		12	24 J	14	0.14 U	0.14	1.3	0.38	0.73 U	0.5	0.99 J	0.52	NS	NS	NS	NS	NS	NS
3-SB-15-G-0-01	8/20/03	14 J		7.5	**29.6** J	9.1	-5 U		12	24 J	14	0.14 U	0.14	1.3	0.38	0.73 U	0.5	0.99 J	0.52	NS	NS	NS	NS	NS	NS
3-SB-17-G-0-01	8/22/03	1.4 U		3.9	**40** J	12	12.4 J		6.9	51 J	17	0.45 J	0.2	6.4 J	1.6	1.48 J	0.71	1.64 J	0.73	NS	NS	NS	NS	NS	NS
3-SB-19-G-0-01	8/25/03	-1 U		3.3	**16.6**	5.5	10.3 U		7	39.1	9.1	0.21 U	0.14	1.3 J	0.56	1.51 J	0.77	1.05 U	0.64	NS	NS	NS	NS	NS	NS
3-SB-20-G-0-01	8/22/03	-0.7 U		2.8	**35.3** J	8.2	7.5 J		4.4	43 J	10	0.63 J	0.28	3.9 J	1	0.01 U	0.44	5.7 U	6.7	NS	NS	NS	NS	NS	NS
3-SB-24-G-0-01	8/21/03	4.2		1.5	**82**	17	16		3.4	100	21	1.15	0.36	12.1	3.1	1.81 J	0.78	7.6 U	5.5	NS	NS	NS	NS	NS	NS
3-SB-25-G-0-01	8/26/03	-0.4 U		4	-2.7 U	4	2.2 U		6.5	5 U	6.2	0.04 U	0.11	0.25 U	0.22	0.38 U	0.52	0.92 U	0.62	NS	NS	NS	NS	NS	NS
3-SB-27-G-0-01	8/22/03	4.6 U		4.9	11.3 J	5.4	5 U		6.4	19.7 J	7.2	0.2 U	0.14	2.46 J	0.89	1.73 J	0.74	2.04 J	0.92	NS	NS	NS	NS	NS	NS
3-SB-30-GU-P-12	6/27/07	NS		NS	2.7 LT	1.2	NS		NS	6.6	2.2	NS	NS	0.86 LT	0.35	NS	NS	0.8 LT	0.46	0.019 U	0.051	0.027 U	0.049	0.039 LT	0.026
3-SB-32-GU-P-12	6/27/07	NS		NS	0.91 U	0.85	NS		NS	4.2	1.8	NS	NS	0.26 LT	0.18	NS	NS	0.4 U	0.42	0.097 U	0.065	0.064 U	0.055	0.034 LT	0.025
3-SB-34-GU-P-12	6/28/07	NS		NS	9.3 M3	4.8	NS		NS	5.6 U,M	6.2	NS	NS	0.94 LT	0.4	NS	NS	0.7 U	0.52	0.074 U	0.057	0.005 U	0.047	0.037 LT	0.023
3-SB-35-GU-P-12	6/28/07	NS		NS	3.1 U,M	2.4	NS		NS	14.1 M3	4.8	NS	NS	0.58 LT	0.27	NS	NS	1.21	0.62	0.083 U	0.057	-0.001 U	0.049	0.027 U	0.024
3-SB-36-GU-P-12	6/28/07	NS		NS	4.3	1.9	NS		NS	6.8 M3	3.3	NS	NS	0.34 Y1,LT	0.19	NS	NS	0.7 U	0.45	0.095 U	0.079	0.13 LT	0.076	0.034 LT	0.028
3-SB-37-GU-P-12	6/28/07	NS		NS	3.4	1.6	NS		NS	8.7 M3	3	NS	NS	1.16	0.43	NS	NS	1.32	0.54	0.016 U	0.075	0.018 U	0.06	0.032 LT	0.023
3-SB-38-GU-P-10	6/28/07	NS		NS	2.8 U,M	3.5	NS		NS	6.1 U,M	6.2	NS	NS	0.38 LT	0.2	NS	NS	0.92 LT	0.53	0.04 U	0.054	0.121 LT	0.057	0.014 U	0.015
3-SB-39-GU-P-12	6/29/07	NS		NS	**52** M3	14	NS		NS	76 M3	18	NS	NS	2.39 Y2	0.74	NS	NS	2.01	0.72	-0.008 U	0.079	0.116 U	0.08	0.044 LT	0.034
AVERAGE		**3.39**			**16.9**		**7.490909091**			**25**		**0.37**		**1.89**		**0.950**		**1.56**		**0.052**		**0.06**		**0.033**	

Notes:

MCL = Maximum Contaminant Level
N/A = Not Applicable
NS = Not Sampled
pCi/L = picocuries per Liter
TPU = Total Propagated Uncertainty

J = Result is an estimated value
LT = Result is less than requested MDC but graeater than sample specific MDC
M = The requested MDC was not met
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.

U = Result is less than the sample specific MDC
Y1 = Chemical yield control is at 100-110%. Quantitative yield is assumed
Y2 = Chemical yield is outside default limits
Shading Indicates detected concentrations which equal or exceed the MCLs

Table 5-13
Metals Exceeding Preliminary Remediation Goals in Groundwater, AOC 3

Analyte	NJDEP Higher of PQL and Ground WQC(ug/L)	Region 6 PRG (mg/L)	3-SB-01-G-0-01	3-SB-01-G-0-02	3-SB-01-G-1-03	3-SB-01-G-1-04	3-SB-02-G-0-01	3-SB-02-G-0-02	3-SB-03-G-0-01	3-SB-03-G-0-02	3-SB-04-G-0-01	3-SB-04-G-0-02	3-SB-05-G-0-01	3-SB-05-G-0-02	3-SB-05-G-1-03	3-SB-05-G-1-04	3-SB-06-G-0-01	3-SB-06-G-0-02	3-SB-07-G-0-01	3-SB-07-G-0-02	3-SB-08-G-0-01
		Sample Date	8/18/03	8/18/03	8/18/03	8/18/03	8/15/03	8/15/03	8/15/03	8/15/03	8/14/03	8/14/03	8/13/03	8/13/03	8/13/03	8/13/03	8/13/03	8/13/03	8/13/03	8/13/03	8/7/03
			Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
			Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag
ALUMINUM	0.2	36.5		53 J		66 J							52 J								
ANTIMONY	0.006	0.0146		0.022 J		0.028 J															
ARSENIC	0.003	0.0000448		0.31 J		420 J					0.032 J	0.033 J	0.029 J			0.01 J	0.015 J	0.023 J	0.011 J	0.015 J	0.012 J
CHROMIUM	0.07	0.11		0.22 J		0.27 J															
IRON	0.3	25.55		220 J		290 J							110 J					26 J			36 J
LEAD	0.005	0.015		1.2 J		1.3 J			0.18 J	0.12 J	3.4 J	3.3 J	23 J	1.5 J	1.6 J	2 J		0.35 J			
MANGANESE	0.05	1.703	1.8 J	2.2 J		2.4 J												1.8 J	3.9 J	2.7 J	4.7 J
MERCURY	0.002	0.00365																			
VANADIUM	N/A	0.183		0.2 J		0.25 J															

Analyte	NJDEP Higher of PQL and Ground WQC(ug/L)	Region 6 PRG (mg/L)	3-SB-08-G-0-02	3-SB-09-G-0-01	3-SB-09-G-0-02	3-SB-10-G-0-01	3-SB-10-G-0-02	3-SB-11-G-0-01	3-SB-11-G-0-02	3-SB-12-G-0-01	3-SB-12-G-0-02	3-SB-13-G-0-01	3-SB-13-G-0-02	3-SB-14-G-0-01	3-SB-14-G-0-02	3-SB-15-G-0-01	3-SB-15-G-0-02	3-SB-17-G-0-01	3-SB-17-G-0-02	3-SB-19-G-0-01	3-SB-19-G-0-02
Sample Date			8/7/03	8/11/03	8/12/03	8/15/03	8/15/03	8/19/03	8/19/03	8/19/03	8/19/03	8/20/03	8/20/03	8/20/03	8/20/03	8/21/03	8/21/03	8/26/03	8/26/03	8/27/03	8/27/03
			Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
			Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag	Result (mg/L) Flag
ALUMINUM	0.2	36.5														55 J	76 J				48
ANTIMONY	0.006	0.0146										0.025 J	0.021 J				0.021 J	0.027 J	0.053 J		0.11
ARSENIC	0.003	0.0000448	0.021 J						0.01	0.021	0.03	0.072 J	0.075 J	0.021 J	0.024 J		0.014 J	0.045 J	0.075 J	0.026	0.054
CHROMIUM	0.07	0.11									0.46										0.39
IRON	0.3	25.55	72 J		33 J	37 J	47 J	29 J	33 J	37 J	110 J	35 J	42 J	160 J	38 J	650 J	730 J	320 J	96 J	240 J	370 J
LEAD	0.005	0.015	0.037 J					4.2 J	4.1 J	1.1 J	14 J	86 J	140 J	86 J	15 J	34 J	39 J	8.6 J	0.32 J	0.58	4.9
MANGANESE	0.05	1.703	4.9 J			10 J	9.8 J	9.4	9.6	4.6	5.4	5.1 J	5.2 J	36 J	6.3 J	18 J	19 J	14 J		7.1	5.7
MERCURY	0.002	0.00365																			0.0062 J
VANADIUM	N/A	0.183																			

Table 5-13
Metals Exceeding Preliminary Remediation Goals in Groundwater, AOC 3
(cont.)

			Sample ID	3-SB-20-G-0-02		3-SB-24-G-0-01		3-SB-24-G-0-02		3-SB-25-G-0-01		3-SB-25-G-0-02		3-SB-27-G-0-01		3-SB-27-G-0-02		3-SB-30-GU-P-12		3-SB-32-GU-P-12		3-SB-34-GU-P-12		3-SB-35-GU-P-12		3-SB-36-GU-P-12		3-SB-37-GU-P-12		3-SB-38-GU-P-10		3-SB-39-GU-P-12		3-SB-8-G-0-01		3-SB-8-G-0-02		3-SB-20-G-0-01	
			Sample Date	8/26/03		8/21/03		8/22/03		8/25/03		8/25/03		8/25/03		8/25/03		6/27/07		6/28/07		6/28/07		6/28/07		7/4/07		7/4/07		7/10/07		7/2/07		9/2/03		9/2/03		8/26/03	
Analyte	NJDEP Higher of PQL and Ground WQC(ug/L)	Region 6 PRG (mg/L)		Unfiltered Result (mg/L)	Flag	Filtered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Filtered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Filtered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Filtered Result (mg/L)	Flag	Unfiltered Result (mg/L)	Flag	Filtered Result	Flag
ALUMINUM	0.2	36.5		*74*	J			*120*	J																													2000	J
ANTIMONY	0.006	0.0146												*0.049*	J	*0.044*	J													*0.047*		*0.059*						20	U
ARSENIC	0.003	0.0000448		*0.051*	J	*0.029*	J	*0.068*	J					*0.062*	J	*0.066*	J			*0.013*		*0.017*		*0.014*		*0.013*				*0.07*		*0.021*		*0.03*	J	*0.034*	J	10	U
CHROMIUM	0.07	0.11		*0.16*	J			*0.21*	J																														
IRON	0.3	25.55		*99*	J	*66*	J	*230*	J					*87*	J	*95*	J	*52*		*29*		*59*		*390*		*130*		*130*		*170*						*28*	J	3800	J
LEAD	0.005	0.015		*0.31*	J			*280*	J	*0.2*		*1.3*		*1*	J	*1.3*	J					*4.1*		*2.5*		*52*		*0.053*		*0.07*		*0.66*	E					13	J
MANGANESE	0.05	1.703																*2.7*		*6.7*		*3.7*		*15*		*4.1*		*6.1*		*2.7*								120	J
MERCURY	0.002	0.00365																																					
VANADIUM	N/A	0.183		*0.22*	J			*0.3*	J																														

Notes:

mg/L = Milligrams per liter
PQL = Practical Quantitation Limit
WQC = Water Quality Criteria
µg/L = Micrograms per Liter
B = Analyte is detected in blank only
J = Estimated result
U = Result is less than the sample specific MDC

Table 5-14
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, AOC 3

		Sample ID	3-SB-30-GU-P-12		3-SB-32-GU-P-12		3-SB-34-GU-P-12		3-SB-35-GU-P-12		3-SB-36-GU-P-12		3-SB-37-GU-P-12		3-SB-38-GU-P-10		3-SB-39-GU-P-12	
		Sample Date	6/27/07		6/28/07		6/28/07		6/28/07		7/4/07		7/4/07		7/10/07		7/2/07	
Analyte	NJDEP Higher of PQL & Ground WQC(ug/L)	Region 6 PRG (ug/L)	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag
SVOC																		
1,2,4-TRICHLOROBENZENE	9	**8.16**					100		6600				19		76			
1,2-DICHLOROBENZENE	600	**49.3**					730		81		200		400		1800			
1,3-DICHLOROBENZENE	600	**14.5**					40						16					
1,4-DICHLOROBENZENE	75	**0.467**	110		180		1300		140		95		570		460		2.3	J
4-CHLOROANILINE	30	**146**	810				300				340		1800		520			
ANILINE	6	**11.8**					81						480		31		22	
NAPHTHALENE	300	**6.2**	61		8600		150		120		73		99		190		160	
VOC																		
1,2,4-TRICHLOROBENZENE	9	**8.16**					120		7200		13	J			97	J		
1,2,4-TRIMETHYLBENZENE	N/A	**12.4**			1500		26	J										
1,2-DICHLOROBENZENE	600	**49.3**			83		990				390		560		2500			
1,2-DICHLOROETHANE	2	**0.123**					34	J			32	J	160	J			6.7	J
1,3,5-TRIMETHYLBENZENE	N/A	**12.3**			450													
1,3-DICHLOROBENZENE	600	**14.5**			16	J	37	J										
1,4-DICHLOROBENZENE	75	**0.467**	140		220		1800				160		1100		530		3.1	J
BENZENE	1	**0.354**	220		760		1500		550	J	200		1000		600		44	
CARBON TETRACHLORIDE	1	**0.171**							450	J								
CHLOROBENZENE	50	**91.3**	1300		4000		10000		810	J	1400		5200		4300			
CHLOROETHANE	N/A	**3.86**															190	
CHLOROFORM	70	**0.167**							7000		120		190	J	430			
CIS-1,2-DICHLOROETHENE	70	**60.8**									920				1200			
ETHYLBENZENE	700	**1340**			1900													
METHYLENE CHLORIDE	3	**4.28**	68		21	J,B	21	J,B	1500				180	J,B	340	B	13	
NAPHTHALENE	300	**6.2**	68		9800		1000	Z			83		87	J	180	J	190	
N-BUTYLBENZENE	N/A	**60.8**			380													
N-PROPYLBENZENE	N/A	**60.8**			80													
TETRACHLOROETHENE	1	**0.105**					12	J	1300		300				180	J		
TOLUENE	600	**2281**																
TRICHLOROETHENE	1	**0.028**			17	J,Z	20	J			81				82	J		
TRICHLOROFLUOROMETHANE	2000	**1288**							25000									
VINYL CHLORIDE	1	**0.015**			14	J					27	J			780		2.5	J

Notes:

PQL = Practical Quantitation Limit
WQC = Water Quality Criteria
µg/L = Micrograms per Liter
J = Estimated result
U = Result is less than the sample specific MDC
Z = Spike recovery not within control limits

Table 5-15
Isotopic and Total Uranium Results for Surface Water, AOC 3

		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
2-SW-01-S-P-01	7/11/05	0.41 J	0.16	0.078 U	0.073	0.42 J	0.16	0.86	1.29 J	0.33
2-SW-02-S-P-01	7/11/05	0.81 J	0.25	0.032 U	0.059	0.76 J	0.24	1.56	2.34 J	0.49
2-SW-03-S-P-01	7/11/05	0.25 J	0.12	-0.005 U	0.056	0.114 J	0.081	0.23	0.34 J	0.17
3-SW-04-SW-P-00	7/10/05	0.55	0.14	0.047 LT	0.038	0.47	0.13	0.97	1.45	0.27
3-SW-05-SW-P-00	7/10/05	1.26	0.27	0.049 U	0.041	1.04	0.23	2.13	3.19	0.47
3-SW-06-SW-P-00	7/10/05	0.082 LT	0.056	0.015 U	0.031	0.099 LT	0.06	0.2	0.30 LT	0.12
3-SW-07-SW-P-00	7/10/05	0.098 LT	0.059	0.006 U	0.028	0.081 LT	0.051	0.17	0.25 LT	0.1
3-SW-08-SW-P-00	7/10/05	0.146 LT	0.075	0.003 U	0.028	0.154 LT	0.07	0.32	0.48 LT	0.14
3-SW-09-SW-P-00	7/10/05	0.31	0.11	0.019 U	0.032	0.3	0.11	0.61	0.91	0.22
3-SW-10-SW-P-00	7/10/05	0.246	0.092	0.015 U	0.028	0.34	0.11	0.7	1.05	0.23
3-SW-11-SW-P-00	7/10/05	0.31	0.11	0.009 U	0.033	0.35	0.12	0.71	1.06	0.25
3-SW-12-SW-P-00	7/10/05	0.173 LT	0.074	0.008 U	0.028	0.076 LT	0.05	0.15	0.22 LT	0.1
3-SW-13-SW-P-00	7/10/05	1.19	0.26	0.054 LT	0.042	1.1	0.25	2.25	3.37	0.51

Notes:

pCi/L = Picocuries per liter

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

U = Result is less than the sample specific MDC

Table 5-16
Total Uranium Results for Sediment Samples, AOC 3

Radionuclide			Offsite Results Uranium (Total)			Onsite Results Uranium (Total)		
Sample Location	Sample ID	Sample Date	Result (pCi/g) Flag	TPU [+/- 2σ]	MDA	Result (pCi/g) Flag	TPU [+/- 2σ]	MDA
			Gamma Spectroscopy			Gamma Spectroscopy		
2-SD-02	2-SD-02-D-P-02	8/1/05	2.5 U	2.3	3.6			
2-SS-01	2-SS-01-D-P-01	7/11/05	2.1 U	3.3	5.5			
2-SS-02	2-SS-02-D-P-01	7/11/05	3.4 U	4.7	7.7			
2-SS-03	2-SS-03-D-P-01	7/11/05	0.4 U	1.3	2.3			
3-SB-01	3-SB-01-B-0-01 (0'-2')	8/13/03				7.91	3.48	1.06
3-SB-02	3-SB-02-B-0-01	8/12/03	**18.8**	5.7	6.7	**22.1**	8.72	1.7
3-SB-03	3-SB-03-B-0-01	8/12/03	7.2	3.1	4.3	8.69	3.87	1.27
3-SB-04	3-SB-04-B-0-01	8/8/03	**30.3**	7.6	7.8	**43.7**	16.7	2.18
3-SB-04	3-SB-04-B-0-06 (0'-2')	8/12/03				**98.2**	36.9	3.54
3-SB-05	3-SB-05-B-0-01 (0'-2')	8/11/03				3.72	1.9	0.735
3-SB-06	3-SB-06-B-0-01 (0'-2')	8/27/03				0.39 U	ND	1.04
3-SB-07	3-SB-07-B-0-01 (0'-2')	8/14/03				-1.11 U	ND	1.65
3-SB-11	3-SB-11-B-0-01 (0'-2')	8/27/03				5.31	2.46	0.84
3-SB-12	3-SB-12-B-0-01 (0'-2')	8/15/03				2.24	2.64	1.6
3-SB-13	3-SB-13-B-0-01 (0'-2')	8/19/03				6.62	3.46	1.49
3-SB-14	3-SB-14-B-0-01 (0'-2')	8/27/03				0.139 U	ND	0.86
3-SB-15	3-SB-15-B-0-01 (0'-2')	8/19/03				-0.174 U	ND	0.744
3-SB-16	3-SB-16-B-0-01 (0'-2')	8/27/03				0.116 U	ND	1.13
3-SB-18	3-SB-18-B-0-01 (0'-2')	8/27/03				-0.09 U	ND	1.18
3-SB-19	3-SB-19-B-0-01 (0'-2')	8/27/03				2.3 U	ND	1.09
3-SS-28	3-SS-28-R-0-01 (0-6")	8/23/03				**79.6**	30.9	5.75

			Offsite Alpha Spectroscopy		
3-SD-04	3-SD-04-SD-P-00	7/10/07	3.14	0.57	0.04
3-SD-05	3-SD-05-SD-P-00	7/10/07	10.1	1.7	0
3-SD-06	3-SD-06-SD-P-00	7/10/07	1.45	0.31	0.07
3-SD-07	3-SD-07-SD-P-00	7/10/07	0.45	0.12	0.05
3-SD-08	3-SD-08-SD-P-00	7/10/07	1.6	0.32	0.01
3-SD-09	3-SD-09-SD-P-00	7/10/07	2.12	0.42	0.05
3-SD-10	3-SD-10-SD-P-00	7/10/07	2.74	0.53	0.04
3-SD-11	3-SD-11-SD-P-00	7/10/07	0.9	0.19	0.05
3-SD-12	3-SD-12-SD-P-00	7/10/07	1.35	0.27	0.05
3-SD-13	3-SD-13-SD-P-00	7/10/07	1.6	0.31	0.04

Notes:

MDA = Minimum Detection Activity

ND = Not Detected

pCi/g = Picocuries per gram

TPU = Total Propagated Uncertainty

U = Result is less than the sample specific MDC

Results in **bold** represent samples exceeding 14 pCi/g

Sediment samples are represented by samples from 0-2' below ground surface

Table 5-17
Radiochemical Results for Surface Water, AOC 3

		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230	
MCL (pCi/L)		15		NA		5 (combined RA226/228)		5 (combined RA226/228)		NA		NA	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
2-SW-01-S-P-01	7/11/05	1.7 U	1.2	16.6	3.7	0.086 U	0.074	0.6 U	0.37	NS	NS	NS	NS
2-SW-02-S-P-01	7/11/05	1 U	1.1	11.2	3	0.2 J	0.11	0.4 U	0.35	NS	NS	NS	NS
2-SW-03-S-P-01	7/11/05	2	1.2	12.5	3.1	-0.003 U	0.043	0.66 U	0.41	NS	NS	NS	NS
3-SW-04-SW-P-00	7/10/07	1.19 LT	0.49	8.8	1.7	0.12 U	0.12	0.62 U	0.47	-0.018 U	0.063	0.099 LT	0.061
3-SW-05-SW-P-00	7/10/07	3.4	1.1	10.5	2.2	0.35 LT	0.2	0.31 U	0.4	-0.045 U	0.056	0.029 U	0.049
3-SW-06-SW-P-00	7/10/07	2.6 U,M	2.3	22.7 M3	5.8	0.16 U	0.13	0.48 U,M	0.54	0.018 Y2,U	0.095	0.012 Y2,U	0.073
3-SW-07-SW-P-00	7/10/07	0.9 U,M	2.1	23.9 M3	6	0.1 U	0.12	0.22 U	0.45	-0.023 U	0.059	0.01 U	0.048
3-SW-08-SW-P-00	7/10/07	0.9 U,M	1.8	20.9 M3	4.7	0.17 U	0.14	0.12 U	0.41	0.021 U	0.049	0.003 U	0.046
3-SW-09-SW-P-00	7/10/07	2.9 LT	1.4	15 M3	3.7	0.16 U	0.14	0.26 U	0.4	0.002 U	0.063	0.08 U	0.057
3-SW-10-SW-P-00	7/10/07	0.5 U	1.5	15.7 M3	4.1	0.07 U	0.1	0.31 U	0.43	0.022 U	0.052	-0.01 U	0.043
3-SW-11-SW-P-00	7/10/07	0.3 U,M	1.8	15.4 M3	4.2	0.17 U	0.15	0.6 U	0.49	0.043 U	0.056	-0.012 U	0.044
3-SW-12-SW-P-00	7/10/07	0.9 U,M	2.2	23.8 M3	6	0.31 LT	0.21	0.16 U,M	0.72	0.074 U	0.059	-0.03 U	0.049
3-SW-13-SW-P-00	7/10/07	5.1 M3	2.6	26.7 M3	6.3	0.25 LT	0.18	0.62 U	0.5	-0.017 U	0.059	-0.06 U	0.068

Notes:

MCL = Maximum Contaminant Level

NS = Not Sampled

pCi/L = Picocuries per Liter

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

M = The requested MDC not met

M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.

U = Result is less than the sample specific MDC

Y2 = Chemical yield outside default limits

Table 5-18
Radiological Isotopic Results for Sediment Samples, AOC 3

Sample Location	Sample ID	Sample Date	RA-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
2-SD-02	2-SD-02-D-P-02	8/1/05	0.38	U	0.31	0.47					1.2	U	1.1	1.7									0.23	U	0.34	0.57				
2-SS-01	2-SS-01-D-P-01	7/11/05	0.83		0.38	0.76					1	U	1.6	2.7									0.41	U	0.48	0.78				
2-SS-02	2-SS-02-D-P-01	7/11/05	0.83		0.32	0.51					1.7	U	2.3	3.8									0.02	U	0.3	0.54				
2-SS-03	2-SS-03-D-P-01	7/11/05	0.42		0.17	0.32					0.2	U	0.64	1.12									0.19	U	0.27	0.44				
3-SB-01	3-SB-01-B-0-01	8/13/03					1.37	J	0.26	0.07																				
3-SB-02	3-SB-02-B-0-01	8/12/03	0.56		0.19	0.34					9.2		2.8	3.3									0.84		0.27	0.42				
3-SB-03	3-SB-03-B-0-01	8/12/03	0.73		0.23	0.33					3.5		1.5	2.1									0.14	U	0.19	0.32				
3-SB-04	3-SB-04-B-0-01	8/12/03	0.49		0.13	0.24					14.8		3.7	3.8									1.02		0.29	0.41				
3-SB-05	3-SB-05-B-0-01	8/11/03					0.34	J	0.08	0.06																				
3-SB-06	3-SB-06-B-0-01	5/11/06					0.71		0.15	0.07																				
3-SB-07	3-SB-07-B-0-01	8/14/03					1.07	J	0.22	0.08																				
3-SB-11	3-SB-11-B-0-01	8/27/03																												
3-SB-12	3-SB-12-B-0-01	8/15/03					0.99	J	0.19	0.07																				
3-SB-13	3-SB-13-B-0-01	8/19/03					0.93	J	0.19	0.07																				
3-SB-14	3-SB-14-B-0-01	8/26/03					0.38	J	0.10	0.07																				
3-SB-15	3-SB-15-B-0-01	5/11/06					0.12		0.06	0.07																				
3-SB-16	3-SB-16-B-0-01	8/26/03					0.64	J	0.15	0.08																				
3-SB-17	3-SB-17-B-0-01	8/26/03																												
3-SB-18	3-SB-18-B-0-01	8/27/03																												
3-SB-19	3-SB-19-B-0-01	8/26/03					0.65	J	0.15	0.08																				
3-SD-04	3-SD-04-SD-P-00	7/10/07	0.46	LT	0.15	0.28	0.39		0.12	0.09	1.6	U	1.3	2	1.41		0.26	0.02	0.08	LT	0.04	0.009	0.22	U	0.26	0.43	1.54		0.28	0.02
3-SD-05	3-SD-05-SD-P-00	7/10/07	0.54	G	0.15	0.27	0.66		0.15	0.07	6	U,M,G	4.3	6.5	5.28		0.88	0.02	0.22		0.06	0.017	0.06	U,G	0.31	0.55	4.92		0.82	0.01
3-SD-06	3-SD-06-SD-P-00	7/10/07	0.59	G	0.23	0.48	0.54		0.15	0.09	5.3	U,M,G	5.8	9.4	0.70		0.15	0.05	0.03	U	0.02	0.031	0.35	U,G	0.45	0.74	0.71		0.15	0.03
3-SD-07	3-SD-07-SD-P-00	7/10/07	0.37	LT	0.16	0.36	0.30		0.09	0.08	-3.2	U,M	3.6	6.9	0.24		0.06	0.02	0.01	U	0.01	0.016	0.03	U	0.3	0.52	0.22		0.06	0.02
3-SD-08	3-SD-08-SD-P-00	7/10/07	0.74	G,T1	0.25	0.45	0.29		0.09	0.08	-2.2	U,M,G	8.2	14.8	0.69		0.14	0.01	0.03	LT	0.02	0.018	0.26	U,G	0.42	0.71	0.78		0.16	0.01
3-SD-09	3-SD-09-SD-P-00	7/10/07	0.56	G	0.18	0.31	0.51		0.13	0.08	-1.4	U,M,G	3.4	6.3	1.09		0.21	0.03	0.02	U	0.02	0.029	0.05	U,G	0.31	0.55	1.04		0.2	0.02
3-SD-10	3-SD-10-SD-P-00	7/10/07	0.92	M3,G	0.27	0.52	0.80		0.18	0.08	1.5	U,M,G	9.7	16.9	1.40		0.27	0.02	0.07	LT	0.04	0.022	0.32	U,G	0.49	0.81	1.34		0.26	0.02
3-SD-11	3-SD-11-SD-P-00	7/10/07	0.4	LT,T1	0.19	0.38	0.22		0.08	0.08	3.3	U,M	4.8	8	0.34		0.08	0.03	0.01	U	0.01	0.024	0.01	U	0.28	0.51	0.44		0.10	0.03
3-SD-12	3-SD-12-SD-P-00	7/10/07	0.42	LT,G,T1	0.18	0.34	0.39		0.11	0.08	0.9	U,M,G	3.5	6	0.73		0.14	0.02	0.05	LT	0.03	0.019	0.1	U,G	0.29	0.49	0.66		0.13	0.02
3-SD-13	3-SD-13-SD-P-00	7/10/07	0.34	U	0.17	0.34	0.15		0.06	0.08	-1.7	U,M	3.2	6	0.79		0.15	0.02	0.03	LT	0.02	0.016	0.16	U	0.27	0.46	0.78		0.15	0.02

Notes:

MDC = Minimum Detectable Concentration

pCi/g = Picocuries per gram

TPU = Total Propagated Uncertainty

G = Sample density differs by more than 15% of LCS density: sample results may be biased

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

M = The requested MDC not met

M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.

TI = Nuclide identification is tentative

U = Result is less than the sample specific MDC

Table 5-19
Metals and Organics Exceeding Preliminary Remediation Goals in Surface Water Samples, AOC 3

		Sample ID	3-SW-04-SW-P-00		3-SW-05-SW-P-00		3-SW-06-SW-P-00		3-SW-07-SW-P-00		3-SW-08-SW-P-00		3-SW-09-SW-P-00		3-SW-10-SW-P-00		3-SW-11-SW-P-00		3-SW-12-SW-P-00		3-SW-13-SW-P-00	
		Sample Date	7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07	
Analyte	NJDEP (Fresh) Surface Water Criteria (ug/L)	Region 6 PRG (ug/L)	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag	Result (ug/L)	Flag
Metals																						
LEAD	5	**15**			48				28		19		24		250		55					
SVOC																						
1,4-DICHLOROBENZENE	550	**0.467**							3.9	J	6.8	J	5.1	J	4.5	J	3.7	J				
VOC																						
1,2-DICHLOROETHANE	0.29	**0.123**											0.59	J	0.62	J	0.69	J				
1,4-DICHLOROBENZENE	550	**0.467**							7.5		12		8.5		7.9		6.8		0.56	J	0.59	J
BENZENE	0.15	**0.354**							1.1	J	7		5.6		5.2		4.5		0.42	J	0.42	J
BROMODICHLOROMETHANE	0.55	**0.181**	14		13						0.85	J	2.9		2.7		2.4		0.84	J	0.84	J
CARBON TETRACHLORIDE	0.33	**0.171**					4		130		90		46		40		30		2.5		2.4	
CHLOROFORM	68	**0.167**	31		29		7.4		38		32		25		24		22		3.1		3.2	
DIBROMOCHLOROMETHANE	0.4	**0.133**	6.3		6.1								2.9		2.7		2.1		0.49	J	0.49	J
METHYLENE CHLORIDE	2.5	**4.28**							5.4	B	7.6	B										
TETRACHLOROETHENE	0.34	**0.105**																	2.1		2.1	
TRICHLOROETHENE	1	**0.028**																			0.21	J
VINYL CHLORIDE	0.082	**0.015**																			0.17	J

Notes:

PRG = Preliminary Remediation Goal
µg/L = Micrograms per Liter
B = Analyte is detected in blank only
J = Estimated result

Table 5-20
Metals and Organics Exceeding Preliminary Remediation Goals in Sediment Samples, AOC 3

		Sample ID	3-SD-04-SD-P-00		3-SD-05-SD-P-00		3-SD-06-SD-P-00		3-SD-07-SD-P-00		3-SD-08-SD-P-00		3-SD-09-SD-P-00		3-SD-10-SD-P-00		3-SD-11-SD-P-00		3-SD-12-SD-P-00		3-SD-13-SD-P-00	
		Sample Date	7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07		7/10/07	
Analyte	NJDEP SED LEL	Region 6 PRG	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag	Result	Flag
Metals (mg/kg)																						
ARSENIC	6	**0.39**	4.6		6		51		1.5		6.5		5.7		11						1.6	
CHROMIUM	NA	**30.1**					61				52		56		65							
LEAD	31	**400**					2900				2100		1200		2600							
PAH (ug/kg)																						
BENZO(A)ANTHRACENE	320	**148**	2600	B	3500	B	460	B			2000	B	2600	B	2800	B						
BENZO(A)PYRENE	370	**14.8**	2100		3100		450		390		1200		1900		2300		33		71		100	
BENZO(B)FLUORANTHENE	NA	**148**	4500		5100		2300		700		2800		4500		4800				190		250	
BENZO(K)FLUORANTHENE	240	**1480**	1600		2000										1600							
DIBENZO(A,H)ANTHRACENE	60	**14.8**	290		310		140		71		160		230		210							
INDENO(1,2,3-CD)PYRENE	200	**148**	930		990		380		190		470		720		640							
PCBs (ug/kg)																						
AROCLOR-1260	5	**222**	62000		2400		400		1300		380		810		470							
SVOCs																						
1,4-DICHLOROBENZENE	NA	**3200**					120000															
VOCs (ug/kg)																						
1,4-DICHLOROBENZENE	NA	**3200**					64000		10000													
BENZENE	NA	**656**						U			1500											
CARBON TETRACHLORIDE	NA	**240**					700000															
CHLOROFORM	NA	**245**					130000															

Notes:

LEL = Lowest Effects Levels
mg/L = Milligrams per liter
PRG = Preliminary Remediation Goal
SED = Sediment
µg/L = Micrograms per Liter
B = Analyte is detected in blank only
J = Estimated result
U = Result is less than the sample specific MDC

Table 5-21
Total Uranium Results for Soil Samples, AOC 5

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth	End Depth	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
5-SB-03	5-SB-03-B-0-01 (0'-2')	9/4/03	0	2				2.42	1.62	0.83
5-SB-03	5-SB-03-B-0-02	9/4/03	2	4	4.7 U	3.9	5.7	-0.21 U		1.13
5-SB-03	5-SB-03-B-0-03 (4'-6')	9/4/03	4	6				-1.47 U		0.96
5-SB-03	5-SB-03-B-0-04 (6'-8')	9/4/03	6	8				0.87 U		0.87
5-SB-03	5-SB-03-B-0-05	9/4/03	8	10	0.2 U	1.2	2	2.48 U		0.98
5-SB-04	5-SB-04-B-0-01	9/4/03	0	2	0.8 U	1.7	2.9	0.92 U		1.06
5-SB-04	5-SB-04-B-0-02 (2'-4')	9/4/03	2	4				1.02 U		1.03
5-SB-04	5-SB-04-B-0-03 (4'-6')	9/4/03	4	6				0.52 U		0.82
5-SB-04	5-SB-04-B-0-04 (6'-8')	9/4/03	6	8				0.98 U		0.79
5-SB-04	5-SB-04-B-0-05	9/4/03	8	10	1.6 U	3.3	5.7	-0.31 U		0.84
5-SB-05	5-SB-05-B-0-01 (0'-2')	9/5/03	0	2				3.38	2.02	0.97
5-SB-05	5-SB-05-B-0-02	9/5/03	2	4	0.2 U	1.2	2	1.23 U		0.99
5-SB-05	5-SB-05-B-0-03 (4'-6')	9/5/03	4	6				-0.03 U		1.00
5-SB-05	5-SB-05-B-0-04 (6'-8')	9/5/03	6	8				0.67 U		0.76
5-SB-05	5-SB-05-B-0-05	9/5/03	8	10	2.3	1.4	1.9	0.75 U		0.88
5-SB-06	5-SB-06-B-0-02	9/5/03	2	4	-0.1 U	1.4	2.7	0.11 U		0.86
5-SB-06	5-SB-06-B-0-03 (4'-6')	9/5/03	4	6				-0.26 U		0.92
5-SB-06	5-SB-06-B-0-04 (6'-8')	9/5/03	6	8				0.08 U		0.87
5-SB-06	5-SB-06-B-0-05	9/5/03	8	10	2.5 U	3.1	4.9	0.09 U		0.95
5-SB-07	5-SB-07-B-0-01(0'-2')	9/8/03	0	2				1.61 U		1.09
5-SB-07	5-SB-07-B-0-02(2'-4')	9/8/03	2	4				2.35 U		1.08
5-SB-07	5-SB-07-B-0-03	9/8/03	4	6	0.6 U	3.7	6.3	2.19 U		0.88
5-SB-07	5-SB-07-B-0-04 (6'-8')	9/8/03	6	8				-0.15 U		0.72
5-SB-07	5-SB-07-B-0-05	9/8/03	8	10	1 U	3.3	5.5	1.02 U		0.89
5-SB-08	5-SB-08-B-0-01 (0'-2')	9/2/03	0	2				1.41 U		1.13
5-SB-08	5-SB-08-B-0-02 (2'-4')	9/2/03	2	4				2.06 U		1.11
5-SB-08	5-SB-08-B-0-03	9/2/03	4	6	1.6 U	3.7	6.1	0.51 U		0.82
5-SB-08	5-SB-08-B-0-04	9/2/03	6	8	-1.6 U	3.3	5.9	0.86 U		0.67
5-SB-08	5-SB-08-B-0-05 (8'-10')	9/2/03	8	10				2.96 U		1.24
5-SB-09	5-SB-09-B-1-01(0'-2')	9/8/03	0	2				1.04	1.12	0.67
5-SB-09	5-SB-09-B-0-01(0'-2')	9/8/03	0	2				2.11 U		0.78
5-SB-09	5-SB-09-B-0-02(2'-4')	9/8/03	2	4				1.48	1.22	0.68
5-SB-09	5-SB-09-B-0-03	9/8/03	4	6	0.4 U	1.5	2.7	3.04 U		1.16
5-SB-09	5-SB-09-B-0-04(6'-8')	9/8/03	6	8				1.70 U		0.93
5-SB-09	5-SB-09-B-1-05(8'-10')	9/8/03	8	10				3.40 U		1.21
5-SB-09	5-SB-09-B-0-05	9/8/03	8	10	1.4 U	4.7	8	5.76 U		1.47
5-SB-10	5-SB-10-B-1-01 (0'-2')	9/3/03	0	2				2.35	2	1.14
5-SB-10	5-SB-10-B-0-01	9/3/03	0	2	1 U	1.6	2.7	1.37 U		1.16
5-SB-10	5-SB-10-B-1-02 (2'-4')	9/3/03	2	4				1.17 U		0.96
5-SB-10	5-SB-10-B-0-02 (2'-4')	9/3/03	2	4				1.69 U		0.94
5-SB-10	5-SB-10-B-1-03 (4'-6')	9/3/03	4	6				1.13	1.21	0.72
5-SB-10	5-SB-10-B-0-03 (4'-6')	9/3/03	4	6				2.56 U		1.13

Table 5-21
Total Uranium Results for Soil Samples, AOC 5
(cont.)

					Offsite Gamma Spectroscopy			Onsite Gamma Spectroscopy		
Radionuclide					Uranium (Total)			Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth	End Depth	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
5-SB-10	5-SB-10-B-1-04 (6'-8')	9/3/03	6	8				-0.81 U		0.91
5-SB-10	5-SB-10-B-0-04 (6'-8')	9/3/03	6	8				1.08 U		1.03
5-SB-10	5-SB-10-B-1-05 (8'-10')	9/3/03	8	10				1.36 U		1.09
5-SB-10	5-SB-10-B-0-05	9/3/03	8	10	2.5 U	3.7	5.9	0.97	1.08	0.65
5-SB-11	5-SB-11-B-0-01 (0'-2')	9/3/03	0	2				2.50	1.78	0.95
5-SB-11	5-SB-11-B-0-02	9/3/03	2	4	1.1 U	1.8	2.9	1.98 U		1.01
5-SB-11	5-SB-11-B-0-03 (4'-6')	9/3/03	4	6				1.55 U		0.99
5-SB-11	5-SB-11-B-0-04 (6'-8')	9/3/03	6	8				1.79 U		0.75
5-SB-11	5-SB-11-B-0-05	9/3/03	8	10	-0.06 U	0.98	1.8	-0.62 U		0.90
5-SB-13	5-SB-13-B-0-01 (0'-2')	9/2/03	0	2				-0.40 U		0.95
5-SB-13	5-SB-13-B-0-02 (2'-4')	9/2/03	2	4				2.72 U		0.97
5-SB-13	5-SB-13-B-0-03 (4'-6')	9/2/03	4	6				1.81 U		0.92
5-SB-13	5-SB-13-B-0-04	9/2/03	6	8	-0.2 U	3.1	5.5	2.36 U		0.83
5-SB-13	5-SB-13-B-0-05	9/2/03	8	10	1.4 U	3.5	5.9	1.47 U		0.86
5-SB-15	5-SB-15-B-0-01 (0'-2')	8/29/03	0	2				1.46 U		0.75
5-SB-15	5-SB-15-B-0-02	8/29/03	2	4	0.2 U	1.2	2	0.32 U		0.85
5-SB-15	5-SB-15-B-0-03 (4'-6')	8/29/03	4	6				0.10 U		0.75
5-SB-15	5-SB-15-B-0-04 (6'-8')	8/29/03	6	8				0.22 U		0.77
5-SB-15	5-SB-15-B-0-05	8/29/03	8	10	0.4 U	3.3	5.5	2.51 U		1.04

Notes:

MDC = Minimum Detectable Concentration

pCi/g = Picocuries per gram

TPU = Total Propagated Uncertainty

U = Result is less than the sample specific MDC

Table 5-22
Radiological Isotopic Results for Soil Samples, AOC 5

Sample Location	Sample ID	Sample Date	Start Depth	End Depth	RA-226 Gamma Spec			Th-230 Alpha Spec			Th-234 Gamma Spec			U-235 Gamma Spec		
					Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
5-SB-03	5-SB-03-B-0-01	9/4/03	0	2				0.262 J	0.092	0.092						
	5-SB-03-B-0-02	9/4/03	2	4	0.63	0.19	0.27				2.3 U	1.9	2.8	-0.13 U	0.21	0.4
	5-SB-03-B-0-05	9/4/03	8	10	0.3	0.14	0.27				0.1 U	0.57	1	0.09 U	0.22	0.38
5-SB-04	5-SB-04-B-0-01	9/4/03	0	2	0.47	0.12	0.19				0.37 U	0.83	1.4	0 U	0.27	0.48
	5-SB-04-B-0-02	9/4/03	2	4				0.265 J	0.076	0.071						
	5-SB-04-B-0-05	9/4/03	8	10	0.35	0.16	0.27				0.8 U	1.6	2.8	0.12 U	0.17	0.28
5-SB-05	5-SB-05-B-0-01	9/5/03	0	2				0.365 J	0.096	0.074						
	5-SB-05-B-0-02	9/5/03	2	4	0.67	0.21	0.31				0.1 U	0.59	1	-0.02 U	0.22	0.39
	5-SB-05-B-0-05	9/5/03	8	10	0.33	0.16	0.26				1.13	0.69	0.95	0 U	0.26	0.46
5-SB-06	5-SB-06-B-0-02	9/5/03	2	4	0.14 U	0.19	0.3				-0.05 U	0.7	1.3	0.01 U	0.26	0.47
	5-SB-06-B-0-04	9/5/03	6	8				0.368	0.089	0.065						
	5-SB-06-B-0-05	9/5/03	8	10	0.29 U	0.17	0.31				1.2 U	1.5	2.4	-0.06 U	0.16	0.3
5-SB-07	5-SB-07-B-0-01	9/8/03	0	2				0.217 J	0.071	0.073						
	5-SB-07-B-0-03	9/8/03	4	6	0.317	0.094	0.16				0.3 U	1.8	3.1	0.06 U	0.27	0.47
	5-SB-07-B-0-05	9/8/03	8	10	0.35	0.16	0.26				0.5 U	1.6	2.7	-0.05 U	0.18	0.34
5-SB-08	5-SB-08-B-0-02	9/2/03	2	4				0.323 J	0.083	0.067						
	5-SB-08-B-0-03	9/2/03	4	6	0.65	0.23	0.41				0.8 U	1.8	3	-0.05 U	0.27	0.49
	5-SB-08-B-0-04	9/2/03	6	8	0.28 U	0.23	0.36				-0.8 U	1.6	2.9	0 U	0.25	0.44
5-SB-09	5-SB-09-B-0-02	9/8/03	2	4				0.44 J	0.11	0.08						
	5-SB-09-B-0-03	9/8/03	4	6	1.07	0.29	0.45				0.18 U	0.73	1.3	-0.11 U	0.29	0.54
	5-SB-09-B-0-05	9/8/03	8	10	0.58	0.19	0.31				0.7 U	2.3	3.9	0.07 U	0.25	0.42
5-SB-10	5-SB-10-B-0-01	9/3/03	0	2	1.44	0.3	0.38				0.48 U	0.78	1.3	-0.12 U	0.34	0.61
	5-SB-10-B-0-02	9/3/03	2	4				0.43 J	0.1	0.07						
	5-SB-10-B-0-05	9/3/03	8	10	0.58	0.2	0.38				1.2 U	1.8	2.9	-0.19 U	0.27	0.51
5-SB-11	5-SB-11-B-0-02	9/3/03	2	4	1.02	0.27	0.4				0.54 U	0.86	1.4	-0.01 U	0.28	0.5
	5-SB-11-B-0-03	9/3/03	4	6				0.87 J	0.18	0.08						
	5-SB-11-B-0-05	9/3/03	8	10	0.45	0.12	0.18				-0.03 U	0.48	0.88	-0.1 U	0.19	0.36
5-SB-13	5-SB-13-B-0-02	9/2/03	2	4				0.45 J	0.11	0.07						
	5-SB-13-B-0-04	9/2/03	6	8	0.31	0.1	0.2				-0.1 U	1.5	2.7	-0.08 U	0.22	0.4
	5-SB-13-B-0-05	9/2/03	8	10	0.7	0.21	0.38				0.7 U	1.7	2.9	0.07 U	0.17	0.29
5-SB-15	5-SB-15-B-0-02	8/29/03	2	4	0.45	0.19	0.31				0.1 U	0.57	1	-0.11 U	0.25	0.47
	5-SB-15-B-0-03	8/29/03	4	6				0.245 J	0.069	0.063						
	5-SB-15-B-0-05	8/29/03	8	10	0.81	0.21	0.32				0.2 U	1.6	2.7	0.2 U	0.23	0.38

Notes:

MDC = Minimum Detectable Concentration
pCi/g = Picocuries per gram
TPU = Total Propagated Uncertainty
J = Estimated result
U = Result is less than the sample specific MDC

Table 5-23
YSI Water Quality Data, AOC 5

Boring	pH	Conductivity µS/cm	Conductivity µS/cm	Temperature [°C]	ORP [mV]	Turbidity [NTU]	Dissolved Oxygen [mg/L]
5-SB-03	6.9	2.54	2540	24.2	-254	105	0.46
5-SB-04	7.1	0.53	530	25.8	-8.7	81.6	0.74
5-SB-05	7.4	0.5	500	23.8	64.1	89.2	1.49
5-SB-06	7.6	1.71	1710	24.6	-25.6	978	1.08
5-SB-07	7.5	4.33	4330	24	-39.8	194	3.56
5-SB-08	7.9	2.58	2580	26.2	222	647	2.64
5-SB-09	7.1	5.59	5590	24.9	-66.5	692	2.59
5-SB-10	7.1	2.34	2340	26.8	141	877	3.98
5-SB-11	6.9	2.75	2750	24.6	226	605	4.27
5-SB-15	6.8	0.01	10	24.8	236	98.3	6.93
AVERAGE	**7.2**	**2.3**	**2288**	**25.0**	**49.5**	**436.7**	**2.8**

Notes:

ºC = Degrees Celsius
mg/L = Milligrams per liter
mS/cm = Micro Siemens per centimeter
mV = Millivolts
NTU = Nephelometric Turbidity Unit
ORP = Oxidation Reduction Potential

Table 5-24
HACH Kit Water Quality Data, AOC 5

Peizometer Location	Fe2+ (mg/L)		NO2- (mg/L)		S2 (mg/L)		SO4 (mg/L)	
	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
5-SB-03	0.01	0.02	0.016	0.023	0.003	0.189	73	37
5-SB-04	0.09	0.1	0.008	0	0.002	0.015	14	4
5-SB-05	0.02	0.09	0.025	0	0.002	0.439	14	5
5-SB-06	0.01	1.4	0.039	0	0.007	0.62	36	0
5-SB-07	0.67	0.32	0.006	0.028	0.019	0	33	28
5-SB-08	0.21	0.2	0	0	0.006	0.143	0	0
5-SB-09	0.25	0.74	0.202	0	0.007	0	0	0
5-SB-10	0.04	0.63	0.004	0.01	0.064	0	1	5
5-SB-11	1.04	1.24	0	0	0.007	0.233	0	0
5-SB-15	0.09	0.21	0.015	0	0	0.397	21	0
AVERAGE	**0.24**	**0.50**	**0.03**	**0.01**	**0.01**	**0.20**	**19**	**8**

Notes:

mg/L = Milligrams per liter

Table 5-25
Major Ions in Groundwater, AOC 5

	Chloride (mg/L)		Nitrate-N (mg/L)		Orthophosphate as P (mg/L)		Total Alkalinity as CaCO3 (mg/L)	
NJDEP WQC	250		10		NA		NA	
Region 6 PRG	**NA**		**10**		**NA**		**NA**	
Sample ID	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**	**Filtered**	**Unfiltered**
	Result Flag	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**	**Result Flag**
5-SB-03-G-0-01	39	36	0.2 U	0.2 U	0.2 U	0.2 U	92 J	90 J
5-SB-04-G-0-01	11	12	0.2 U	0.2 U	0.2 U	0.58 J	79 J	75 J
5-SB-05-G-0-01	16 J	12 J	0.2 U	0.2 U	0.2 U	0.61 J	110 J	110 J
5-SB-06-G-0-01	110 J	110 J	0.2 U	0.2 U	0.2 U	0.26 J	270 J	260 J
5-SB-07-G-0-01	790 J	810 J	1 U	1 U	1 U	1 U	140 J	140 J
5-SB-09-G-0-01	850 J	860 J	1 U	1 U	1 U	1 U	360 J	350 J
5-SB-10-G-0-01	1200 J	1100 J	1 U	1 U	3.9 J	4.5 J	740 J	760 J
5-SB-11-G-0-01	410 J	410 J	0.4 U	0.4 U	0.4 U	0.4 U	260 J	250 J
5-SB-11-G-1-01	420 J	440 J	0.4 U	0.4 U	0.4 U	0.4 U	250 J	250 J
5-SB-15-G-0-01	49 J	46 J	0.2 U	0.2 U	0.2 U	0.2 U	101 J	101 J
AVERAGE	**390**	**384**	**0.48**	**0.48**	**0.77**	**0.92**	**240**	**239**

Notes:

$CaCO_3$ = Calcium carbonate
mg/L = Milligrams per liter
NA = Not Applicable
PRG = Preliminary Remediation Goal
WQC = Water Quality Criteria
J = Estimated result
U = Result is less than the sample specific MDC

Table 5-26
Isotopic and Total Uranium in Groundwater, AOC 5

		U-234				U-235			
		Filtered		Unfiltered		Filtered		Unfiltered	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
5-SB-03-G-0-01	9/4/03	0.167 UJ	0.098	20.1 J	3.1	0.008 U	0.056	0.91 J	0.34
5-SB-04-G-0-01	9/4/03	0.169 UJ	0.099	2.44 J	0.48	0.006 U	0.057	0.101 U	0.088
5-SB-05-G-0-01	9/5/03	0.071 U	0.079	5.92	0.96	-0.005 U	0.060	0.36	0.16
5-SB-06-G-0-01	9/5/03	0.72	0.22	2.66	0.52	0.048	0.057	0.136	0.096
5-SB-07-G-0-01	9/8/03	0.28	0.11	9.3	1.6	0.056 U	0.063	0.34	0.25
5-SB-09-G-0-01	9/8/03	0.33	0.13	0.32	0.12	0.101	0.071	0.019 U	0.040
5-SB-10-G-0-01	9/3/03	0.89 J	0.25	3.72 J	0.65	0.034 U	0.061	0.2 J	0.12
5-SB-11-G-0-01	9/3/03	0.79 J	0.23	1.38 J	0.32	0.058 U	0.063	0.063 J	0.062
5-SB-11-G-1-01	9/3/03	0.22 U	0.11	0.4 J	0.15	0.05 U	0.059	0.025 U	0.051
5-SB-13-G-0-01	9/3/03	0.39 J	0.16	NS	NS	0.066 J	0.065	NS	NS
5-SB-15-G-0-01	8/29/03	0.39	0.15	1.18	0.29	0.025 U	0.051	0.052 U	0.062
	AVERAGE	**0.40**		**4.7**		**0.04**		**0.22**	

		U-238				Uranium (Total)					
		Filtered		Unfiltered		Filtered			Unfiltered		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
5-SB-03-G-0-01	9/4/03	0.065 U	0.067	16.7 J	2.6	0.13	0.19 U	0.14	34.2	**51.3** J	5.3
5-SB-04-G-0-01	9/4/03	0.136 J	0.086	2.84 J	0.54	0.28	0.42 J	0.18	5.8	8.7 J	1.1
5-SB-05-G-0-01	9/5/03	0.083	0.071	5.47	0.90	0.17	0.25	0.15	11.2	16.8	1.8
5-SB-06-G-0-01	9/5/03	0.48	0.17	2.89	0.55	0.98	1.47	0.35	5.9	8.8	1.1
5-SB-07-G-0-01	9/8/03	0.178 U	0.089	9.6	1.6	0.36	0.54 U	0.18	19.6	29.4	3.3
5-SB-09-G-0-01	9/8/03	0.33	0.12	0.31	0.12	0.67	1.00	0.25	0.63	0.9	0.25
5-SB-10-G-0-01	9/3/03	0.63 J	0.21	3.19 J	0.58	1.29	1.93 J	0.43	6.5	9.7 J	1.2
5-SB-11-G-0-01	9/3/03	0.68 J	0.21	1.29 J	0.31	1.39	2.08 J	0.43	2.64	4.0 J	0.63
5-SB-11-G-1-01	9/3/03	0.124	0.078	0.24 J	0.11	0.25	0.37	0.16	0.49	0.7 J	0.22
5-SB-13-G-0-01	9/3/03	0.47 J	0.17	NS	NS	0.96	1.44 J	0.35	NS	NS	NS
5-SB-15-G-0-01	8/29/03	0.24	0.11	1.17	0.29	0.49	0.73	0.22	2.39	3.58	0.59
	AVERAGE	**0.31**		**4.37**		**0.63**	**0.95**		**8.9**	**13.4**	

Notes:

pCi/L = Picocuries per liter
TPU = Total Propagated Uncertainty
µg/L = Micrograms per Liter
J = Estimated result
U = Result is less than the sample specific MDC

pCi/L results are converted to ug/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 5-27
Radiochemical Analysis of Groundwater, AOC 5

		GROSS ALPHA				GROSS BETA				RA-226				RA-228			
MCL (pCi/L)		15				NA				5 (RA-226/288 combined)				5 (RA-226/288 combined)			
		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
5-SB-03-G-0-01	**9/4/03**	0.56 U	0.9	14.4 J	2.9	8.8 J	2.3	29.5 J	5.4	0.17 U	0.14	8.5 J	2.1	0.95 U	0.74	1.7 J	0.86
5-SB-04-G-0-01	**9/4/03**	0.13 U	0.77	12.4 J	2.6	9.8 J	2.4	27 J	4.8	0.02 U	0.082	**1.71** J	0.45	0.28 U	0.5	**3.5** U	5.2
5-SB-05-G-0-01	**9/5/03**	0.43 U	0.68	**41.7** J	8.2	9.2 J	2.2	69 J	12	0.16 U	0.13	**6.6**	1.7	0.67 U	0.6	**2.2** J	1
5-SB-06-G-0-01	**9/5/03**	0.57 U	0.95	**51** J	11	17.4 J	3.2	80 J	15	0.24	0.15	**10.5**	2.8	1.34 J	0.74	**5.5** U	6
5-SB-07-G-0-01	**9/8/03**	0.8 U	2.1	**406**	78	21.2	4.7	510	95	0.48	0.22	**27**	7.2	1.01 U	0.68	**16** U	13
5-SB-09-G-0-01	**9/8/03**	3.6 U	2.4	**52**	14	11	3.6	64	17	1.2	0.39	**8.1**	2.1	2.27 J	0.96	**4.1** J	1.5
5-SB-10-G-0-01	**9/3/03**	5.5	2.4	**111**	22	12.9	3.9	111	22	0.91	0.31	**15.2**	3.8	1.33 U	0.8	0.4 U	5.3
5-SB-11-G-0-01	**9/3/03**	0.7 U	1.4	**28.1**	6	14.5	3.2	47.3	8.9	0.52	0.21	**3.06**	0.8	0.57 U	0.47	**3.3** J	1.3
5-SB-11-G-1-01	**9/3/03**	1.6 U	1.5	6.2	2.4	13.5	3.2	25.1	5	0.47	0.21	0.96	0.43	0.75 U	0.6	0.97 U	0.7
5-SB-13-G-0-01	**9/3/03**	0.59 U	0.69	NS	NS	9.6	2.1	NS	NS	1.99	0.57	NS	NS	0.49 U	0.56	NS	NS
5-SB-15-G-0-01	**8/29/03**	0.89 U	0.58	4.6 J	1.3	4 J	1.2	9.8 J	2.2	0.13 U	0.13	2.8 J	1	0.58 U	0.6	1.77 J	0.81

MCL = Maximum Contaminant Level
NA = Not Applicable
NS = Not Sampled
pCi/L = picocuries per liter
J = Estimated result
U = Result is less than the sample specific MDC
Shading indicates detected concentrations which equal or exceed the MCLs

Table 5-28
Metals Exceeding Preliminary Remediation Goals in Groundwater, AOC 5

	Sample ID		5-SB-06-G-0-01		5-SB-06-G-0-02		5-SB-07-G-0-02		5-SB-09-G-0-01		5-SB-09-G-0-02		5-SB-10-G-0-01		5-SB-10-G-0-02		5-SB-11-G-0-02		5-SB-11-G-1-01		5-SB-11-G-1-02		5-SB-15-G-0-01		5-SB-15-G-0-02	
	Sample Date		9/5/03		9/5/03		9/8/03		9/8/03		9/8/03		9/3/03		9/3/03		9/3/03		9/3/03		9/3/03		8/29/03		8/29/03	
Metals	**Result (ug/L)**	**Region 6 PRG (mg/L)**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**	**Result (mg/L)**	**Flag**
ALUMINUM	0.2	**36.5**			*88*	J	*220*	J			*81*	J			*51*	J	*57*	J								
ANTIMONY	0.006	**0.0146**																								
ARSENIC	0.003	**0.0000448**	*0.018*	J	*0.075*	J	*0.12*	J	*0.011*	J	*0.018*	J	*0.027*	J	*0.032*	J	*0.025*	J	*0.011*	J	*0.011*	J	*0.016*	J	*0.033*	J
CHROMIUM	0.07	**0.11**			*0.14*	J	*0.57*	J									*0.13*	J								
COPPER	1.3	**1.356**																							*1.7*	J
IRON	0.3	**25.55**			*130*	J	*390*	J			*49*	J			*55*	J	*90*	J	*28*	J	*41*	J			*30*	J
LEAD	0.005	**0.015**			*0.42*	J	*0.68*	J			*0.059*	J			*0.033*	J	*0.072*	J							*0.26*	J
MANGANESE	0.05	**1.703**					*1.8*	J																		
MERCURY	**0.002**	**0.00365**					*0.0037*	J																		
VANADIUM	N/A	**0.183**					*0.58*	J							*0.22*	J										

Notes:

mg/L = Milligrams per liter

PRG = Preliminary Remediation Goal

WQC = Water Quality Criteria

J = Estimated result

Table 5-29
Isotopic and Total Uranium in Monitoring Wells, AOC 5

		U-234		U-235		U-238		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
C08M01B-GU-23	7/5/07	0.5	0.18	0.017 U	0.055	0.42	0.17	0.86	1.29	0.34
D07M01-GU-P-09	7/10/07	0.127 LT	0.061	0.007 U	0.026	0.102 LT	0.054	0.21	0.31 LT	0.11
D08M01A-GU-P-09	7/9/07	0.121 LT	0.091	0.037 U	0.056	0.08 U	0.072	0.16	0.24 U	0.15
D08P02B-GU-23	7/5/07	0.049 U	0.056	0.006 U	0.051	0.105 LT	0.074	0.21	0.31 LT	0.15

Notes:

pCi/L = Picocuries per liter

TPU = Total Propagated Uncertainty

µg/L = Micrograms per Liter

U = Result is less than the sample specific MDC

LT = Result is less than requested MDC but greater than sample specific MDC

Table 5-30
Radiochemical Analysis in Monitoring Wells, AOC 5

		GROSS ALPHA		GROSS BETA		RA-226		RA-228		Th-228		Th-230		Th-232	
MCL		15				5 (combined RA226/228)		5 (combined RA226/228)							
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
C08M01B-GU-23	**7/5/07**	11.9	3	8.4 M3	3.5	0.79 Y1,LT	0.32	0.64 U	0.49	0.34	0.12	0.122 LT	0.076	0.1 LT	0.055
D07M01-GU-P-09	**7/10/07**	0.8 U	0.79	56.9	9.4	0.2 LT	0.15	0.53 U	0.49	0.105 LT	0.064	0.069 U	0.052	0.031 LT	0.021
D08M01A-GU-P-09	**7/9/07**	0.33 U	0.93	11.9	3	0.1 U	0.11	0.71 U	0.5	0.008 U	0.067	0.033 U	0.059	0.022 U	0.022
D08P02B-GU-23	**7/5/07**	0.5 U	1	8.4 M3	2.9	0.16 Y1,U	0.13	0.24 U	0.39	0.016 U	0.065	0.034 U	0.058	0.017 U	0.022

Notes:

MCL = Maximum Contaminant Level

pCi/L= Picocuries per liter

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.

U = Result is less than the sample specific MDC

Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed

Table 5-31
Metals Exceeding Preliminary Remediation Goals in Monitoring Wells, AOC 5

Analyte		ARSENIC		LEAD	
NJDEP WQC (mg/L)		0.003		0.005	
Region 6 Tap Water Screening Level (mg/L)		**4.4821E-05**		**0.015**	
Sample ID	**Sample Date**	**Result (ug/L)**	**Flag**	**Result (ug/L)**	**Flag**
C08M01B-GU-23	**7/5/07**	0.082		0.022	
D07M01-GU-P-09	**7/10/07**	0.018			
D08M01A-GU-P-09	**7/9/07**	0.013			

Notes:

mg/L = Milligrams per liter

WQC = Water Quality Criteria

Table 5-32
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Monitoring Wells, AOC 5

		SVOA										VOA		
		1,2,4-TRICHLOROBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	4-CHLOROANILINE	ANILINE	CARBAZOLE	DIBENZOFURAN	HEXACHLOROBUTADIENE	NAPHTHALENE	1,2,4-TRICHLOROBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE
NJDEP WQC (ug/L)		9	600	600	75	30	6	NA	NA	1	300	9	600	600
Region 6 PRG (ug/L)		**8.16**	**49.3**	**14.5**	**0.467**	**146**	**11.8**	**3.36**	**12.2**	**0.862**	**6.2**	**8.16**	**49.3**	**14.5**
Sample ID	**Sample Date**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**
C08M01B-GU-23	**7/5/07**	550	1100	26	240	190	420				48	640	2200	46 J
D07M01-GU-P-09	**7/10/07**	52	63		25							63	440	
D08M01A-GU-P-09	**7/9/07**	16	1200		12			5.4 J	13	19	59	23 J	1600	
D08P02B-GU-23	**7/5/07**		1500		14								3600	

Table 5-32
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Monitoring Wells, AOC 5
(cont.)

		VOA (cont.)												
		1,2,4-TRICHLOROBENZENE	1,4-DICHLOROBENZENE	BENZENE	CARBON TETRACHLORIDE	CHLOROBENZENE	CHLOROFORM	CIS-1,2-DICHLOROETHENE	HEXACHLOROBUTADIENE	METHYLENE CHLORIDE	NAPHTHALENE	TETRACHLOROETHENE	TRICHLOROETHENE	VINYL CHLORIDE
NJDEP WQC (ug/L)		9	75	1	1	50	70	70	1	3	300	1	1	1
Region 6 PRG (ug/L)		**8.16**	**0.467**	**0.354**	**0.171**	**91.3**	**0.167**	**60.8**	**0.862**	**4.28**	**6.2**	**0.105**	**0.028**	**0.015**
Sample ID	**Sample Date**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**
C08M01B-GU-23	**7/5/07**	640	380	160	18 J	1600	57 J	84 J		30 J,B	44 J	100	200	81 J
D07M01-GU-P-09	**7/10/07**	63	49					230		9.5 J,B		6 J	7.9 J	15 J
D08M01A-GU-P-09	**7/9/07**	23 J	21 J	15 J					31 J	46 J,B	62	270	36 J	
D08P02B-GU-23	**7/5/07**		30 J	27 J	1200	210	210			76 J,B		39 J		

Notes:

ug/L = Micrograms per Liter
WQC = Water Quality Criteria
J = Estimated result

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Table 6-1
Total Uranium Results for Groundwater Geoprobe Samples, AOC 4

Boring #	Sample ID	Sample Date	Result (µg/L)	Reporting Limit (µg/L)	Comments
4-GP-01	4-GP-01	4/28/2006	460	1	
4-GP-01	5-GP-01	5/3/2006	340	1	Duplicate
4-GP-02	4-GP-02	4/27/2006	3.5	1	
4-GP-03	4-GP-03	4/28/2006	ND	1	
4-GP-04	4-GP-04	4/28/2006	1.9	1	
4-GP-04	5-GP-04	5/3/2006	ND	1	Duplicate
4-GP-05	NA	NA	NA		Boring Not Performed
4-GP-06	4-GP-06	4/28/2006	21	20	
4-GP-07	4-GP-07	5/2/2006	35	1	
4-GP-08	4-GP-08	5/2/2006	110	1	
4-GP-09	4-GP-09	5/2/2006	2.0	1.0	
4-GP-10	4-GP-10	5/2/2006	ND	1	
4-GP-11	NA	NA	NA		Boring Not Performed
4-GP-12	4-GP-12	4/27/2006	1	1	
4-GP-13	4-GP-13	4/28/2006	ND	1	
4-GP-14	4-GP-14	4/28/2006	9.5	1	
4-GP-15	4-GP-15	5/2/2006	22	1	
4-GP-16	4-GP-16	5/3/2006	ND	1	
4-GP-16	5-GP-16	5/3/2006	ND	1	Duplicate
4-GP-17	4-GP-17	5/3/2006	1.1	1	
5-GP-17	5-GP-17	5/3/2006	1.3	1	Duplicate
4-GP-18	4-GP-18	5/2/2006	13	1	
4-GP-19	NA	NA	NA		Boring Not Performed
4-GP-20	NA	NA	NA		Boring Not Performed
4-GP-21	4-GP-21	4/28/2006	7.1	1	
4-GP-22	NA	NA	NA		Boring Not Performed
4-GP-23	4-GP-23	5/2/2006	ND	1	
4-GP-24	4-GP-24	4/28/2006	2.3	5	
4-GP-25	4-GP-25	5/2/2006	1.4	1	
4-GP-26	NA	NA	NA		Boring Not Performed
4-GP-27	4-GP-27	5/3/2006	ND	1	

Notes:

µg/L = micrograms per liter

NA = Not Applicable

ND = Not Detected

Samples analyzed onsite by New Age/Landmark using SW6020

Borings were advanced to a depth of 10 feet below ground surface (Aquifer A)

Table 6-2
Total Uranium Results for Groundwater Geoprobe Samples, AOC 6

Boring No	Sample ID	Sample Date	Sample Depth (ft bgs)	Result (µg/L)	Reporting Limit (µg/L)	Comments
6-GP-01	6-GP-01	4/28/2006	14	3.5	1	
6-GP-02	6-GP-02	4/28/2006	14	ND	1	Uranium not detected
6-GP-03	6-GP-03	4/28/2006	14	14	1	
6-GP-04	6-GP-04	5/3/2006	44	ND	1	Uranium not detected

Notes:

ft bgs = Feet below ground surface

ID = Identification

No = Number

µg/L = micrograms per liter

Samples analyzed onsite by New Age/Landmark using SW6020

Borings were advanced in the B Aquifer

Table 6-3:
Soil Boring FIDLER Scan Results
AOC 4 AOI 1

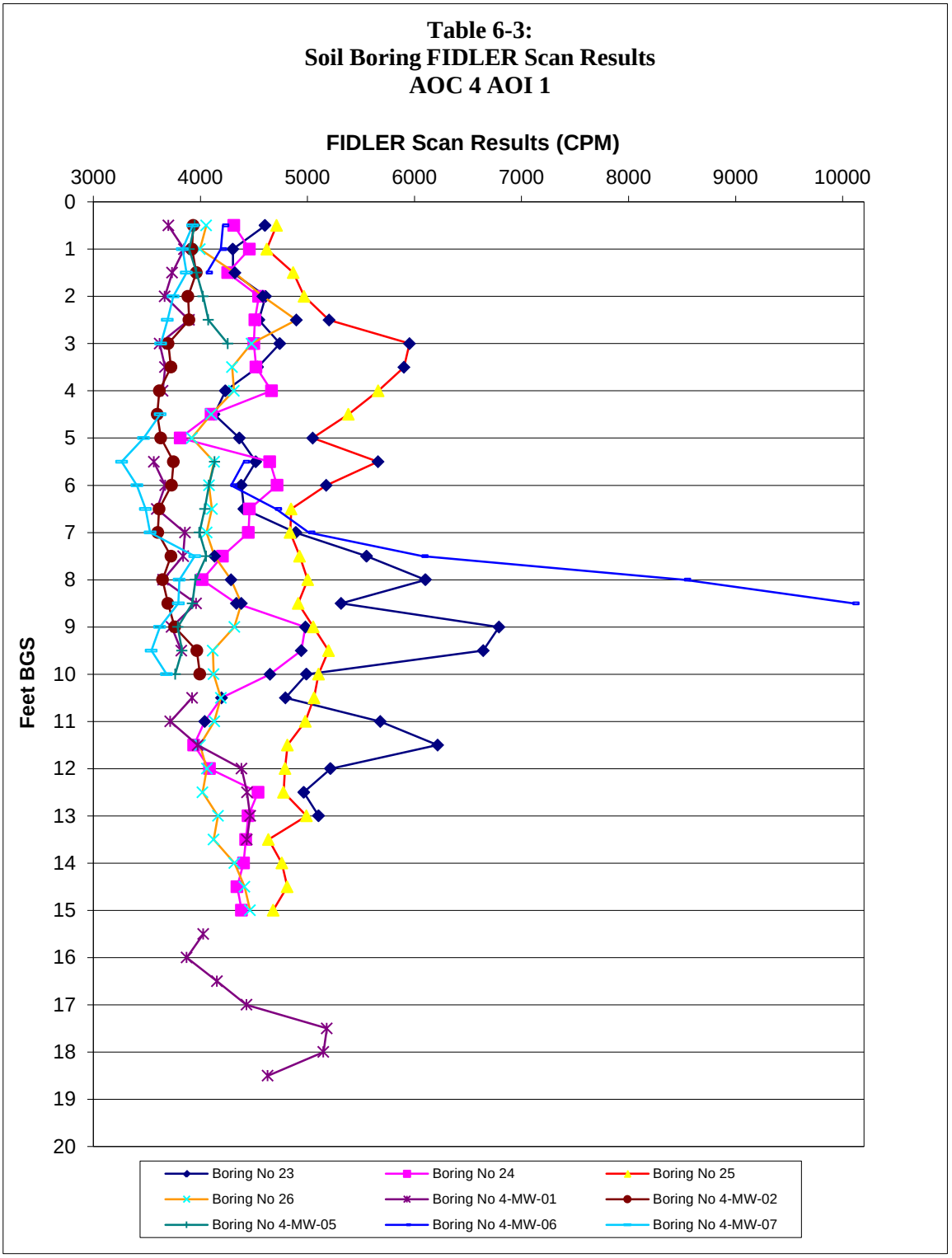

Table 6-4:
Soil Boring FIDLER Scan Results
OU 3 AOC 4 AOI 2

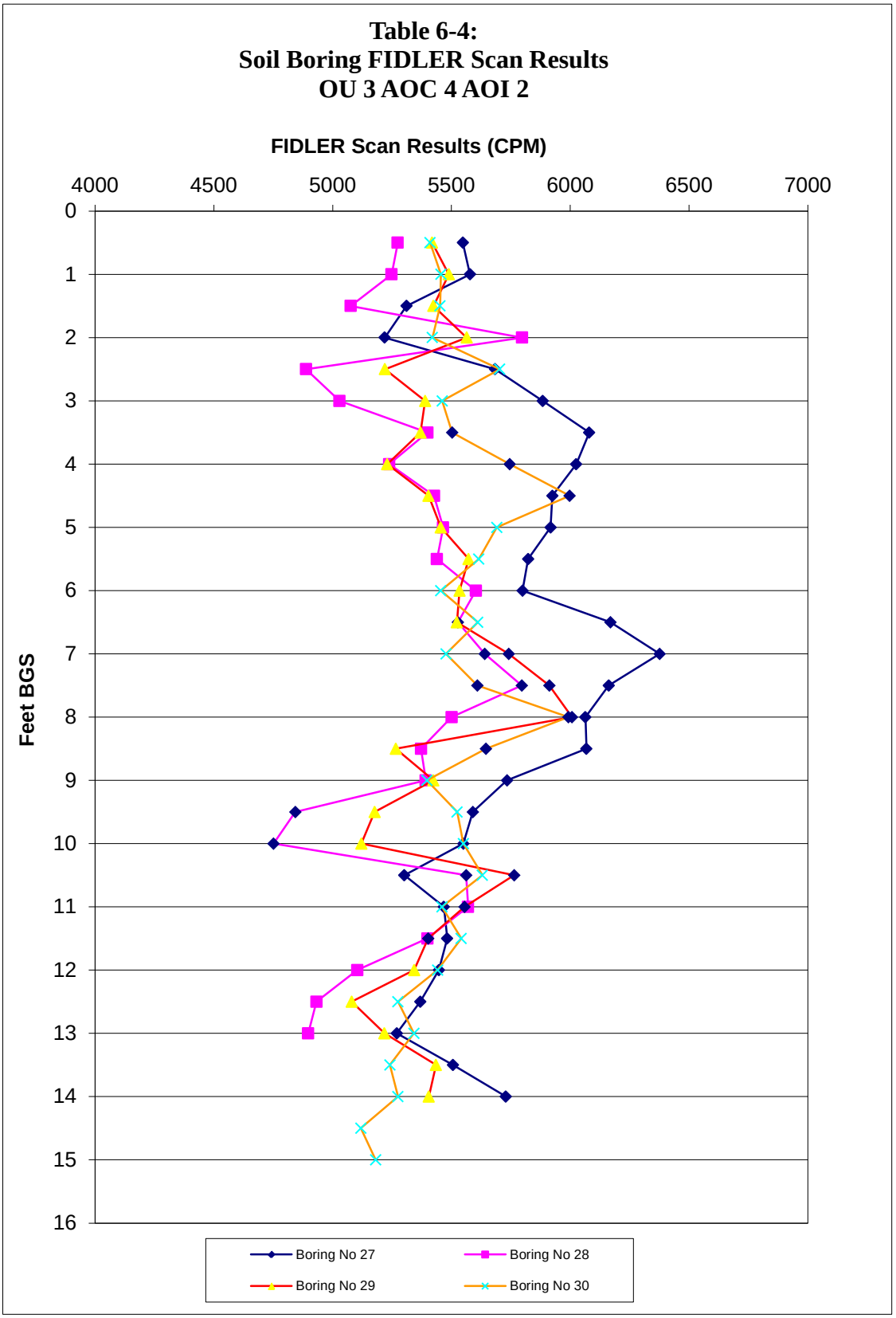

Table 6-5
Total Uranium Results for Soil Samples, AOC 4

					Offsite Gamma Spectroscopy		
					Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
4CPT-12	4CPT-12-B-P-14	11/12/04	14	15	1 U	2.9	4.9
4CPT-16	4CPT-16-B-P-12.5	11/15/04	12.5	13.5	1.4 U	1.8	2.9
4CPT-22	4CPT-22-B-P-6.5	11/15/04	6.5	7.5	3.2 U	4.9	8.1
4CPT-33	4CPT-33-B-P-5	1/15/04	5	6	1.2 U	2	3.3
4CPT-62A[1]	4CPT-62A-B-P-0.5	10/25/04	0.5	1.5	**11700**	1400	300
4-MW-01	4-MW-01-B-P-17	5/8/06	17	17.5	4.5 U	2.9	4.5
	4-MW-01-B-P-18	5/8/06	18	18.5	2 U	2.8	4.7
4-MW-02	4-MW-02-B-P-09	5/8/06	9	9.5	2.2 U	2.8	4.7
	4-MW-02-B-P-10	5/8/06	10	10.5	7.6 U	5.1	7.8
4-MW-05	4-MW-05-B-P-03	5/8/06	2.5	3	**14.6**	7.2	10.6
	4-MW-05-B-P-09	5/8/06	8.5	9	3.8 U	4.1	6.6
4-MW-06	4-MW-06-B-P-01	5/9/06	0	1.5	2.6 U	4.8	8
	4-MW-06-B-P-08	5/8/06	7.5	8.5	**355**	60	55
4-MW-07	4-MW-07-B-P-07	11/9/05	7	7.5	3 U	3.4	5.6
	4-MW-07-B-P-09	11/9/05	9	9.5	4 U	4.6	7.5
4-SB-23	4-SB-23-B-P-09	11/9/05	8.5	9.5	**108**	15	8
	4-SB-23-B-P-10	11/9/05	10.5	11.5	7.9	3.6	5
4-SB-24	4-SB-24-B-P-09	11/9/05	8.5	9.5	**21.3**	5	5.7
	4-SB-24-B-P-10	11/9/05	10	11	1.8 U	2.3	3.8
4-SB-25	4-SB-25-B-P-03	11/9/05	2.5	3.5	**23.2**	5.3	5.7
	4-SB-25-B-P-05	11/9/05	5	6	10.7	3.2	4
4-SB-26	4-SB-26-B-P-02	11/9/05	1.5	2.5	**14.8**	4	4.7
	4-SB-26-B-P-08	11/9/05	7.5	8.5	2 U	2.1	3.4
4-SB-27	4-SB-27-B-P-06	11/10/05	6	7	2.1 U	2.9	4.8
	4-SB-27-B-P-09	11/10/05	9	10	0 U	1.5	2.7
4-SB-28	4-SB-28-B-P-07	11/10/05	6.5	7.5	4 U	2.6	4
	4-SB-28-B-P-10	11/10/05	10	11	-0.5 U	1.7	3.1
4-SB-29	4-SB-29-B-P-07	11/10/05	7	8	0.9 U	1.9	3.2
	4-SB-29-B-P-11	11/10/05	10.5	11.5	1.2 U	1.4	2.3
4-SB-30	4-SB-30-B-P-04	11/9/05	3.5	4.5	0.5 U	1.7	3
	4-SB-30-B-P-08	11/9/05	7.5	8.5	0.5 U	1.6	2.8

Table 6-5
Total Uranium Results for Soil Samples, AOC 4
(cont.)

					Offsite Alpha Spectroscopy		
					Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
4-SB-31	4-SB-31-SS-P-00	7/3/07	0	1	1.8	0.42	0.06
	4-SB-31-BS-P-05	7/3/07	5	6	0.48	0.16	0.09
4-SB-32	4-SB-32-SS-P-00	7/29/07	0	1	2.61	0.51	0.05
	4-SB-32-BS-P-01	7/29/07	1	2	4.95	0.91	0.05
4-SB-33	4-SB-33-SS-P-00	7/29/07	0	1	2.63	0.51	0.06
	4-SB-33-BS-P-05	7/29/07	5	6	7.6	1.4	0
4-SB-34	4-SB-34-SS-P-00	7/29/07	0	1	2.17	0.44	0.05
	4-SB-34-BS-P-07	7/29/07	7	8	**48.3**	8.2	0.1
4-SB-35	4-SB-35-SS-P-00	7/29/07	0	0	3.75	0.7	0.04
	4-SB-35-BS-P-02	7/29/07	2	3	1.47	0.32	0.05
4-SB-36	4-SB-36-SS-P-00	7/3/07	0	1	2.63	0.54	0.08
	4-SB-36-BS-P-03	7/3/07	3	4	2.86	0.59	0.07
4-SB-37	4-SB-37-SS-P-00	7/3/07	0	1	1.8	0.4	0.1
	4-SB-37-BS-P-04	7/3/07	4	5	0.45 Y2	0.19	0.11
4-SB-38	4-SB-38-SS-P-00	7/3/07	0	1	5.8	1.1	0.1
	4-SB-38-BS-P-02	7/3/07	2	3	2.7	0.55	0.07
4-SB-39	4-SB-39-SS-P-00	7/3/07	0	1	1.06	0.28	0.08
	4-SB-39-BS-P-01	7/3/07	1	2	0.65	0.2	0.07
4-SB-40	4-SB-40-SS-P-00	7/3/07	0	1	2.18	0.53	0.04
	4-SB-40-BS-P-06	7/3/07	6	7	9.6	1.7	0.1

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
pCi/g = picoCuries per gram
TPU = Total Propagated Uncertainty
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits
[1] This is a debris sample
Samples in **bold** represent results exceeding 14pCi/g

Table 6-6
Laboratory Total Uranium Concentrations vs. Net FIDLER Readings

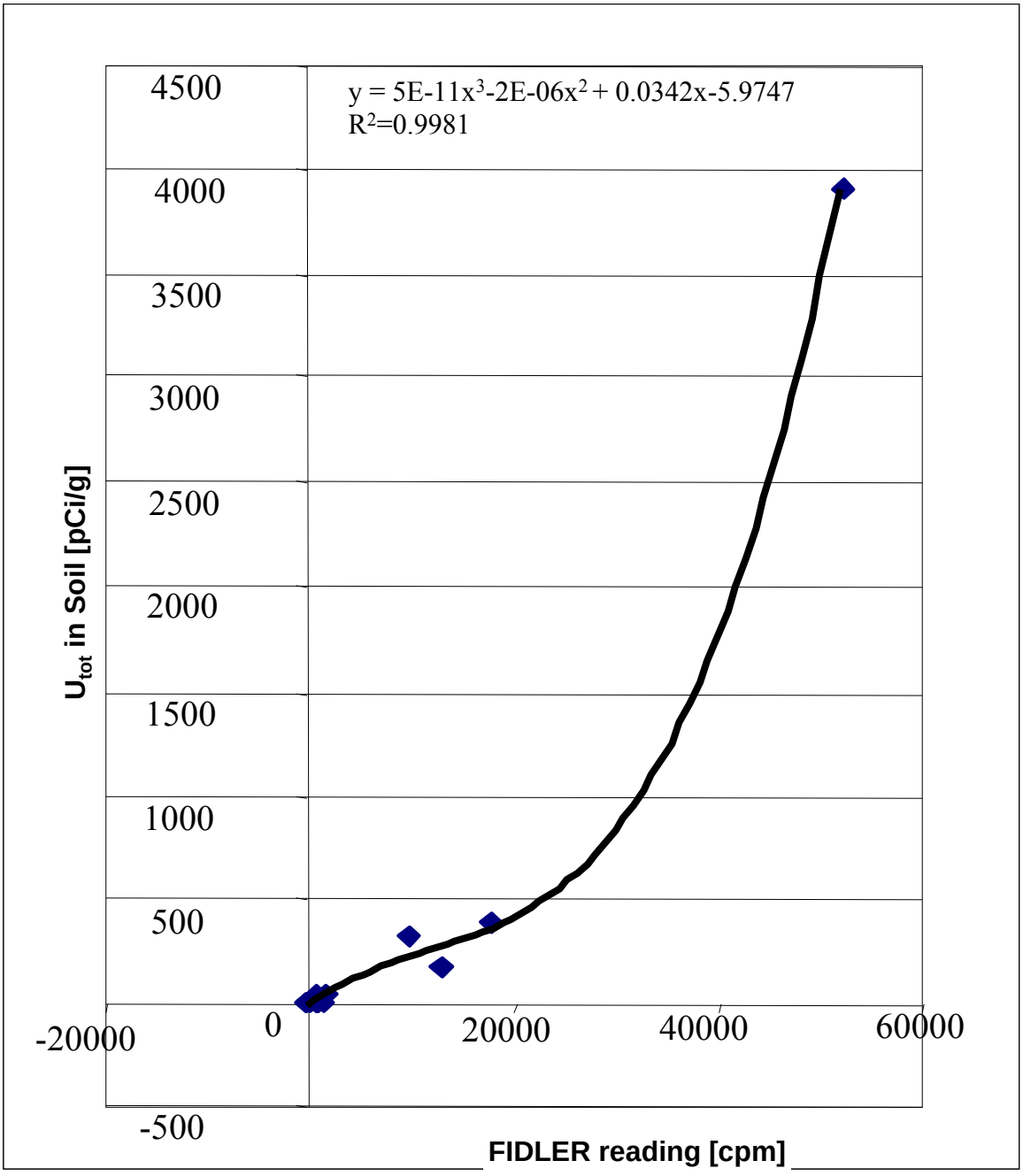

Table 6-7
Radiological Isotopic Results for Soil Samples, AOC 4

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Ra-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
4-CPT-12	4CPT-12-B-P-14	11/12/04	14	15	1.5		0.32	0.49					0.5	U	1.4	2.4									0.1	U	0.15	0.25				
4-CPT-16	4CPT-16-B-P-12.5	11/15/04	12.5	13.5	0.92		0.23	0.45					0.66	U	0.86	1.41									0.22	U	0.34	0.57				
4-CPT-22	4CPT-22-B-P-6.5	11/15/04	6.5	7.5	0.7		0.26	0.48					1.6	U	2.4	4									0.2	U	0.23	0.37				
4-CPT-23	4CPT-33-B-P-5	11/15/04	5	6	0.92		0.2	0.31					0.6	U	0.97	1.61									0.03	U	0.34	0.6				
4-CPT-24	4CPT-62A-B-P-0.5	10/25/04	0.5	1.5	0.76		0.2	0.44					5720		680	140									282		34	9				
4-MW-01	4-MW-01-B-P-17	5/8/06	17	17.5	2.73		0.42	0.42	1.74		0.37	0.1	2.2	U	1.4	2.2									0.08	U	0.45	0.77				
	4-MW-01-B-P-18	5/8/06	18	18.5	1.95		0.35	0.44	2.31		0.48	0.1	1	U	1.4	2.3									-0.27	U	0.38	0.69				
4-MW-02	4-MW-02-B-P-09	5/8/06	9	9.5	0.66		0.24	0.49	0.59		0.15	0.09	1.1	U	1.4	2.3									0.18	U	0.12	0.23				
	4-MW-02-B-P-10	5/8/06	10	10.5	1.13		0.27	0.5	0.72		0.17	0.1	3.7	U	2.5	3.8									0.63	U	0.7	1.13				
4-MW-05	4-MW-05-B-P-03	5/8/06	2.5	3	1.15		0.27	0.44	1.58		0.32	0.09	7.2		3.5	5.2									0.74		0.33	0.74				
	4-MW-05-B-P-09	5/8/06	8.5	9	0.98		0.3	0.57	0.73		0.18	0.1	1.9	U	2	3.2									-0.25	U	0.59	1.13				
4-MW-06	4-MW-06-B-P-01	5/9/06	0	1.5	0.93		0.23	0.36	0.56		0.15	0.1	1.3	U	2.3	3.9									0.15	U	0.15	0.24				
	4-MW-06-B-P-08	5/9/06	7.5	8.5	4.42		0.71	0.73	26.4		4.4	0.1	174		29	27									10.9		1.6	1.7				
4-MW-07	4-MW-07-B-P-07	5/8/06	7	7.5	0.63		0.25	0.47	0.78		0.18	0.09	1.5	U	1.7	2.7									-0.1	U	0.41	0.76				
	4-MW-07-B-P-09	5/8/06	9	9.5	0.72		0.27	0.71	0.5		0.13	0.09	2	U	2.3	3.7									-0.05	U	0.73	1.34				
4-SB-23	4-SB-23-B-P-09	11/9/05	8.5	9.5	1.92		0.46	0.77					52.7		7.1	3.9									3.39		0.71	1.01				
	4-SB-23-B-P-10	11/9/05	10.5	11.5	0.43	U	0.22	0.5					3.9		1.7	2.5									0.25	U	0.35	0.57				
4-SB-24	4-SB-24-B-P-09	11/9/05	8.5	9.5	0.95		0.21	0.43					10.4		2.5	2.8									1.2		0.61	0.9				
	4-SB-24-B-P-10	11/9/05	10	11	0.17	U	0.29	0.5					0.9	U	1.1	1.8									0.05	U	0.25	0.45				
4-SB-25	4-SB-25-B-P-03	11/9/05	2.5	3.5	1.08		0.36	0.61					11.3		2.6	2.8									0.68	U	0.47	0.72				
	4-SB-25-B-P-05	11/9/05	5	6	0.96		0.3	0.53					5.3		1.6	2									0.77		0.48	0.72				
4-SB-26	4-SB-26-B-P-02	11/9/05	1.5	2.5	0.96		0.31	0.6					7.3		1.9	2.3									0.65	U	0.44	0.67				
	4-SB-26-B-P-08	11/9/05	7.5	8.5	0.79		0.29	0.56					1	U	1	1.7									-0.09	U	0.36	0.65				
4-SB-27	4-SB-27-B-P-06	11/10/05	6	7	0.73		0.24	0.46					1	U	1.4	2.3									-0.12	U	0.34	0.62				
	4-SB-27-B-P-09	11/10/05	9	10	0.55		0.23	0.5					0.02	U	0.74	1.31									0.01	U	0.26	0.46				
4-SB-28	4-SB-28-B-P-07	11/10/05	6.5	7.5	1.34		0.28	0.47					2	U	1.3	2									0.44	U	0.38	0.59				
	4-SB-28-B-P-10	11/10/05	10	11	0.52		0.22	0.39					-0.25	U	0.85	1.52									-0.09	U	0.27	0.48				
4-SB-29	4-SB-29-B-P-07	11/10/05	7	8	0.78		0.24	0.47					0.43	U	0.92	1.55									-0.11	U	0.27	0.5				
	4-SB-29-B-P-11	11/10/05	10.5	11.5	0.46		0.19	0.36					0.57	U	0.69	1.12									0.14	U	0.22	0.37				
4-SB-30	4-SB-30-B-P-04	11/9/05	3.5	4.5	0.87		0.25	0.4					0.24	U	0.84	1.45									0.05	U	0.3	0.53				
	4-SB-30-B-P-08	11/9/05	7.5	8.5	0.87		0.27	0.52					0.24	U	0.79	1.36									0.31	U	0.29	0.45				
4-SB-31	4-SB-31-SS-P-00	7/3/07	0	1	0.69	G	0.19	0.35	0.52		0.12	0.09	0	U,M,G	3.5	6.2	1.07		0.24	0.03	0.11		0.06	0.03	-0.07	U,G	0.3	0.55	0.88		0.21	0.03
	4-SB-31-BS-P-05	7/3/07	5	6	0.21	U	0.12	0.3	0.09	LT	0.047	0.074	0.15	U	0.9	1.57	0.22		0.08	0.04	0.01	U	0.02	0.04	-0.19	U	0.25	0.48	0.24		0.08	0.04
4-SB-32	4-SB-32-SS-P-00	6/29/07	0	1	0.45	LT,G	0.17	0.34	0.348		0.081	0.053	1	U,G	1.5	2.5	1.26		0.25	0.02	0.07	LT	0.04	0.01	-0.02	U,G	0.32	0.57	1.28		0.25	0.03
	4-SB-32-BS-P-01	6/29/07	1	2	0.57	G	0.19	0.36	0.61		0.14	0.07	3.3	U,M,G	4.6	7.7	2.54		0.46	0.02	0.09	LT	0.04	0.03	0.03	U,G	0.35	0.62	2.42		0.44	0.02
4-SB-33	4-SB-33-SS-P-00	6/29/07	0	1	0.66	G	0.2	0.34	0.59		0.14	0.07	1.7	U,M,G	4.2	7.2	1.24		0.24	0.03	0.08	LT	0.04	0.01	0.19	U,G	0.38	0.64	1.29		0.25	0.03
	4-SB-33-BS-P-05	6/29/07	5	6	0.97	G	0.24	0.36	0.95		0.19	0.07	4.5	U,M,G	4.9	7.8	3.79		0.67	0.03	0.20		0.07	0.02	-0.2	U,G	0.42	0.77	3.72		0.66	0.01
4-SB-34	4-SB-34-SS-P-00	6/29/07	0	1	0.61	G	0.19	0.3	0.45		0.11	0.07	0.8	U,G	1.2	2	1.12		0.23	0.03	0.09	LT	0.04	0.01	-0.05	U,G	0.32	0.57	1.06		0.22	0.03
	4-SB-34-BS-P-07	6/29/07	7	8	4.01	M3,G	0.59	0.55	17.1		2.7	0.1	29.2	M3,G	10	14.1	23.6		4	0	1.25		0.27	0.03	2.48	G	0.76	1.69	23.60		4.00	0.00
4-SB-35	4-SB-35-SS-P-00	6/29/07	0	0	1.1		0.22	0.34	1.33	Y2	0.25	0.07	0.22	U	0.93	1.61	1.6		0.3	0.02	0.08	LT	0.04	0.01	0.08	U	0.28	0.49	1.83		0.34	0.02
	4-SB-35-BS-P-02	6/29/07	2	3	0.7	G	0.2	0.35	0.51		0.12	0.07	2	U,M,G	2.6	4.4	0.75		0.16	0.03	0.05	LT	0.03	0.02	0.06	U,G	0.37	0.65	0.72		0.16	0.03
4-SB-36	4-SB-36-SS-P-00	7/3/07	0	1	0.65	G	0.19	0.31	0.42	M3	0.12	0.1	1	U,G	1.4	2.4	1.32		0.27	0.03	0.09	LT	0.05	0.03	0.12	U,G	0.32	0.55	1.29		0.26	0.04
	4-SB-36-BS-P-03	7/3/07	3	4	0.65	G	0.21	0.42	0.67		0.15	0.09	0.7	U,G	1.4	2.4	1.24		0.26	0.04	0.15		0.07	0.04	-0.08	U,G	0.38	0.69	1.40		0.29	0.04
4-SB-37	4-SB-37-SS-P-00	7/3/07	0	1	0.29	U	0.15	0.29	0.229	Y2	0.08	0.091	0.8	U,M	3.1	5.3	0.97		0.21	0.04	0.07	LT	0.04	0.03	0.16	U	0.27	0.46	0.88		0.19	0.05
	4-SB-37-BS-P-04	7/3/07	4	5	0.16	U,G	0.2	0.33	0.117		0.058	0.082	0.7	U,G	1.2	2	0.16	Y2	0.08	0.053	0.00	Y2,U	0.04	0.06	0.25	U,G	0.29	0.47	0.22	Y2	0.10	0.05
4-SB-38	4-SB-38-SS-P-00	7/3/07	0	1	0.7	G	0.19	0.36	0.5	M3	0.13	0.1	0.5	U,M,G	3.5	6.1	2.78		0.5	0.03	0.21		0.08	0.03	-0.05	U,G	0.32	0.58	2.84		0.51	0.04
	4-SB-38-BS-P-02	7/3/07	2	3	0.62	G	0.2	0.37	0.328		0.093	0.091	1.2	U,G	1.4	2.3	1.27		0.26	0.03	0.08	LT	0.05	0.03	-0.01	U,G	0.3	0.54	1.32		0.27	0.03
4-SB-39	4-SB-39-SS-P-00	7/3/07	0	1	0.56	G	0.18	0.35	0.197		0.068	0.084	-0.8	U,M,G	3.9	7.1	0.57		0.15	0.04	0.06	LT	0.04	0.03	-0.01	U,G	0.26	0.47	0.52		0.14	0.04
	4-SB-39-BS-P-01	7/3/07	1	2	0.31	LT,G,T1	0.17	0.29	0.314		0.09	0.091	0.9	U,M,G	3.7	6.5	0.36		0.11	0.04	0.03	U	0.03	0.04	-0.08	U,G	0.35	0.64	0.32		0.10	0.04
4-SB-40	4-SB-40-SS-P-00	7/3/07	0	1	0.78	G	0.21	0.38	0.46		0.12	0.1	0.5	U,G	1.1	1.9	1.25		0.29	0.07	0.04	U	0.04	0.05	0.02	U,G	0.35	0.62	1.07		0.26	0.02
	4-SB-40-BS-P-06	7/3/07	6	7	3.06	M3,G	0.48	0.53	2.23	M3	0.4	0.1	6.2	U,M,G	6.5	10.5	4.06		0.73	0.04	0.63		0.17	0.03	0.1	U,G	0.58	1	4.69		0.83	0.03

Notes:

ft bgs = Feet below ground surface
pCi/g = picoCuries per gram
TPU = Total Propagated Uncertainty
MDC = Minimum Detectable Concentration
G = Sample density differs by more than 15% of LCS density: sample results may be biased
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits

Table 6-8
Metals Exceeding Preliminary Remediation Goals in Soil Samples, AOC 4

			Analyte	ANTIMONY		ARSENIC		CHROMIUM		LEAD		MERCURY		NICKEL	
			NJDEP SCC (mg/kg)	14		20		NA		400		14		250	
			Region 6 PRG (mg/kg)	**31.3**		**0.39**		**30.1**		**400**		**6.11**		**1564**	
Sample ID	**Sample Date**	**Start Depth/ End Depth (ft)**		**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**	**Result (mg/kg)**	**Flag**
4-SB-31-BS-P-05	7/3/07	5 / 6				1.4									
4-SB-32-BS-P-01	7/5/07	1 / 2				5.2				580					
4-SB-32-SS-P-00	7/5/07	0 / 1				6		48		1400					
4-SB-33-BS-P-05	7/5/07	5 / 6				3.4									
4-SB-33-SS-P-00	7/5/07	0 / 1				2									
4-SB-34-BS-P-07	7/5/07	7 / 8				20		77							
4-SB-34-SS-P-00	7/5/07	0 / 1				6.4		34							
4-SB-35-BS-P-02	7/5/07	2 / 3				2				610					
4-SB-35-SS-P-00	7/5/07	0 / 1				3.9									
4-SB-36-BS-P-03	7/3/07	3 / 4				7.4									
4-SB-36-SS-P-00	7/3/07	0 / 1				1.8									
4-SB-37-BS-P-04	7/3/07	4 / 5				3.3		46							
4-SB-37-SS-P-00	7/3/07	0 / 1				3		47		480					
4-SB-38-BS-P-02	7/3/07	2 / 3				3.4									
4-SB-38-SS-P-00	7/3/07	0 / 1				2.7				690					
4-SB-39-BS-P-01	7/3/07	1 / 2				2.3		31	N						
4-SB-39-SS-P-00	7/3/07	0 / 1				1.9									
4-SB-40-BS-P-06	7/3/07	6 / 7		36		4.2		43		5000		9.4		18000	
4-SB-40-SS-P-00	7/3/07	0 / 1				3.8		31		850					

Notes:

ft = Feet
mg/kg = milligrams per kilogram
NA = Not Applicable
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
N = Matrix spike recovery outside control limits

Table 6-9
VOCs and SVOCs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 4

		Sample ID	4-SB-31-BS-P-05		4-SB-32-BS-P-01		4-SB-32-SS-P-00		4-SB-33-SS-P-00		4-SB-34-BS-P-07		4-SB-34-SS-P-00		4-SB-36-BS-P-03		4-SB-36-SS-P-00		4-SB-38-BS-P-02		4-SB-38-SS-P-00		4-SB-40-BS-P-06		4-SB-40-SS-P-00	
		Sample Date	7/3/07		7/5/07		7/5/07		7/5/07		7/5/07		7/5/07		7/3/07		7/3/07		7/3/07		7/3/07		7/3/07		7/3/07	
		StartDepth / EndDepth (ft bgs)	5 / 6		1 / 2		0 / 1		0 / 1		7 / 8		0 / 1		3 / 4		0 / 1		2 / 3		0 / 1		6 / 7		0 / 1	
Analyte	NJDEP SCC (µg/kg)	Reg 6 PRG (µg/kg)	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag	Result (µg/kg)	Flag
SVOC																										
HEXACHLOROBENZENE	660	**304**																	76000							
VOC																										
1,2,4-TRIMETHYLBENZENE	NA	**52100**																					78000			
1,2-DICHLOROBENZENE	5100000	**279000**																	1900000				1600000			
1,3-DICHLOROBENZENE	5100000	**68500**																					120000			
1,4-DICHLOROBENZENE	570000	**3200**																	1400000				510000			
BENZENE	3000	**656**																	8300				42000	J		
NAPHTHALENE	230000	**125000**																	2700000							
TETRACHLOROETHENE	4000	**554**																	14000				200000			
TOLUENE	1000000	**521000**																					910000			

Notes:

ft bgs = Feet below ground surface
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
µg/kg = micrograms per kilogram
J = Estimated result

Table 6-10
PAHs and PCBs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 4

			Sample ID	4-SB-31-BS-P-05		4-SB-32-BS-P-01		4-SB-32-SS-P-00		4-SB-33-BS-P-05		4-SB-33-SS-P-00		4-SB-34-BS-P-07		4-SB-34-SS-P-00		4-SB-35-BS-P-02	
			Sample Date	7/3/07		7/5/07		7/5/07		7/5/07		7/5/07		7/5/07		7/5/07		7/5/07	
			StrtDpth / EndDpth (ft)	5 / 6		1 / 2		0 / 1		5 / 6		0 / 1		7 / 8		0 / 1		2 / 3	
Analyte	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)		Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
PAHs																			
BENZO(A)ANTHRACENE	900	**148**		400	B	13000	B	5400	B	470	B			280	B	360	B		
BENZO(A)PYRENE	660	**14.8**		310		6500		3300		280		61		240		290		27	
BENZO(B)FLUORANTHENE	900	**148**		300		8200		3600		270				290		530		160	
BENZO(K)FLUORANTHENE	900	**1480**				2200													
CHRYSENE	9000	**14800**				25000													
DIBENZO(A,H)ANTHRACENE	660	**14.8**		28		910		640		33				57		62		19	
INDENO(1,2,3-CD)PYRENE	900	**148**				2200		1200								150			
PCBs																			
AROCLOR-1254	NA	**222**																	

Table 6-10
PAHs and PCBs Exceeding Preliminary Remediation Goals for Soil Samples, AOC 4
(cont.)

			Sample ID	4-SB-36-BS-P-03		4-SB-36-SS-P-00		4-SB-37-BS-P-04		4-SB-37-SS-P-00		4-SB-38-BS-P-02		4-SB-38-SS-P-00		4-SB-40-BS-P-06		4-SB-40-SS-P-00	
			Sample Date	7/3/07		7/3/07		7/3/07		7/3/07		7/3/07		7/3/07		7/3/07		7/3/07	
			StrtDpth / EndDpth (ft)	3 / 4		0 / 1		4 / 5		0 / 1		2 / 3		0 / 1		6 / 7		0 / 1	
Analyte	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)		Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
PAHs																			
BENZO(A)ANTHRACENE	900	**148**				800	B					1700	B	640	B	3000	B	220	B
BENZO(A)PYRENE	660	**14.8**		23		510		43		65		1100		460		1300		140	
BENZO(B)FLUORANTHENE	900	**148**				680		160				3500		450		2400		170	
BENZO(K)FLUORANTHENE	900	**1480**																	
CHRYSENE	9000	**14800**																	
DIBENZO(A,H)ANTHRACENE	660	**14.8**				60		17	J			120	J	65		140		29	
INDENO(1,2,3-CD)PYRENE	900	**148**										340				350			
PCBs																			
AROCLOR-1254	NA	**222**														810			

Notes:

ft = Feet
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
µg/kg = micrograms per kilogram
B = Analyte is detected in blank only
J = Estimated result

Table 6-11
Water Level Data, AOC 4

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
A Aquifer							
Q4	6/12/06	4-MW-02A	8.73	11.14	2	5.65	3.08
Q5	9/14/06	4-MW-02A	8.73	11.14	2	5.10	3.63
Q6	2/12/07	4-MW-02A	8.73	11.14	2	6.32	2.41
Q7	5/9/07	4-MW-02A	8.73	11.14	2	5.5	3.23
					AVERAGE	**5.6425**	**3.0875**
Q4	6/13/06	4-MW-05A	7.89	10.62	2	4.31	3.58
Q5	9/18/06	4-MW-05A	7.89	10.62	2	4.13	3.76
Q6	2/12/07	4-MW-05A	7.89	10.62	2	5.02	2.87
Q7	5/9/07	4-MW-05A	7.89	10.62	2	4.23	3.66
					AVERAGE	**4.4225**	**3.4675**
Q4	6/12/06	4-MW-06A	9.61	10.55	2	5.23	4.38
Q5	9/14/06	4-MW-06A	9.61	10.55	2	5.13	4.48
Q6	2/12/07	4-MW-06A	9.61	10.55	2	5.90	3.71
Q7	5/9/07	4-MW-06A	9.61	10.55	2	4.8	4.81
					AVERAGE	**5.265**	**4.345**
Q4	6/13/06	4-MW-07A	7.23	10.88	2	4.12	3.11
Q5	9/13/06	4-MW-07A	7.23	10.88	2	3.67	3.56
Q6	2/12/07	4-MW-07A	7.23	10.88	2	4.91	2.32
Q7	5/9/07	4-MW-07A	7.23	10.88	2	3.97	3.26
					AVERAGE	**4.1675**	**3.0625**
Q2	11/18/05	4-I17-M01A	8.34	11.68	2	8.15	0.19
Q3	1/26/06	4-I17-M01A	8.34	11.68	2	6.38	1.96
Q4	6/15/06	4-I17-M01A	8.34	11.68	2	3.46	4.88
Q5	9/15/06	4-I17-M01A	8.34	11.68	2	4.19	4.15
Q6	2/13/07	4-I17-M01A	8.34	11.68	2	5.53	2.81
Q7	5/7/07	4-I17-M01A	8.34	11.68	2	3.49	4.85
					AVERAGE	**5.2**	**3.14**
Q4	6/13/06	4-I17-P01A	8.54	7.00	2	3.31	5.23
Q5	9/14/06	4-I17-P01A	8.54	7.00	2	4.45	4.09
Q6	2/13/07	4-I17-P01A	8.54	7.00	2	5.39	3.15
Q7	5/9/07	4-I17-P01A	8.54	7.00	2	3.61	4.93
					AVERAGE	**4.19**	**4.35**
					A AQUIFER AVERAGE	**4.84**	**3.54**
B Aquifer							
Q4	6/13/06	4-MW-01B	7.17	21.86	10	4.15	3.02
Q5	9/18/06	4-MW-01B	7.17	21.86	10	3.70	3.47
Q6	2/12/07	4-MW-01B	7.17	21.86	10	5.00	2.17
Q7	5/9/07	4-MW-01B	7.17	21.86	10	4.05	3.12
					AVERAGE	**4.225**	**2.945**
Q4	5/5/06	4-H17-M02B	8.23	24.98	10	7.72	0.51
Q5	9/14/06	4-H17-M02B	8.23	24.98	10	7.56	0.67
Q6	2/13/07	4-H17-M02B	8.23	24.98	10	8.91	-0.68
Q7	5/7/07	4-H17-M02B	8.23	24.98	10	7.78	0.45
					AVERAGE	**7.9925**	**0.2375**
					B AQUIFER AVERAGE	**6.11**	**1.59**

Notes:

Elev = Elevation
ft = Feet
GW = Groundwater
NAVD88 = North American Vertical Datum of 1988

Table 6-12
YSI Water Quality Data, AOC 4

Quarter	Date	Well ID	Temp. °C	pH	Cond. (µS/cm^3)	Turbidity (NTU)	DO (mg/L)	ORP (mV)
A Aquifer								
Q4	6/12/06	4-MW-02A	16.45	7	735	9.1	0.3	-134.7
Q5	9/14/06		20.74	6.86	555	0	0.9	-119
Q6	2/12/07		8.48	7.10	435	51	UL	-91
Q7	5/9/07		19.95	7.04	652	16	LL	-139
		AVERAGE	**16.41**	**7.00**	**594.08**	**18.91**	**0.61**	**-121.01**
Q4	6/13/06	4-MW-05A	18.60	7.33	1814	0	0.7	-132
Q5	9/18/06		22.31	6.47	1582	0	0.5	-130
Q6	2/12/07		9.82	7.43	1753	36	LL	-5
Q7	5/9/07		17.32	7.22	1769	11	0.1	-133
		AVERAGE	**17.01**	**7.11**	**1729.62**	**11.75**	**0.41**	**-100.19**
Q4	6/12/06	4-MW-06A	17.39	8.50	2948	10	0.2	-285
Q5	9/14/06		22.57	7.91	3030	9	0.0	-240
Q6	2/12/07		7.82	7.16	2293	113	UL	-80
Q7	5/9/07		18.28	7.04	3088	39	0.0	-115
		AVERAGE	**16.52**	**7.65**	**2839.96**	**42.54**	**0.06**	**-179.94**
Q4	6/13/06	4-MW-07A	17.41	6.71	2165	6	0.4	-132
Q5	9/13/06		22.2	6.72	1855	10	2.5	-150
Q6	2/12/07		6.16	6.98	2423	81	LL	-38
Q7	5/9/07		14.67	6.86	2269	19	LL	-139
		AVERAGE	**15.11**	**6.82**	**2178.18**	**28.80**	**1.44**	**-114.73**
Q2	11/18/05	4-I17-M01A	12.47	7.12	2	1	0.7	-93
Q3	1/26/06		9.0	7.05	3	8	--	-145
Q4	6/15/06		17.5	7.22	3713	0	0.2	-141
Q5	9/15/06		23.4	7.31	3719	10	0.3	-142
Q6	2/13/07		8.99	7.34	1801	29	LL	-10
Q7	5/7/07		18.09	7.24	1056	2	LL	-131
		AVERAGE	**14.90**	**7.21**	**1715.79**	**8.41**	**0.41**	**-110.29**
Q4	6/13/06	4-I17-P01A	21.57	6.46	2438	270	1.2	-27
Q5	9/14/06		23.15	6.24	2542	87	5.4	-93
Q6	2/13/07		5.91	6.72	2680	828	LL	-120
		AVERAGE	**16.9**	**6.5**	**2553.3**	**395.1**	**3.3**	**-79.7**
		A AQUIFER AVERAGE	**16.01**	**7.08**	**1892.88**	**65.75**	**0.88**	**-118.58**
B Aquifer								
Q4	6/13/06	4-MW-01B	19.35	6.73	2061	6.3	0.4	-146
Q5	9/18/06		20.99	7.01	1813	4	1.0	162
Q6	2/12/07		7.68	7.10	1266	53	0.1	-150
Q7	5/9/07			7.08	1815	12	0.0	-162
		AVERAGE	**16.01**	**6.98**	**1738.78**	**18.81**	**0.36**	**-74.06**
Q4		4-H17-M02B						
Q5	9/14/06		18.29	6.34	2277	5	UL	-133
Q6	2/13/07		12.39	6.53	1859	52	UL	-111
Q7	5/7/07		18.14	6.41	2481	LL	LL	-113
		AVERAGE	**16.3**	**6.4**	**2205.8**	**28.7**	**N/A**	**-118.9**
		B AQUIFER AVERAGE	**16.14**	**6.74**	**1938.94**	**22.11**	**0.36**	**-93.26**

Notes:

°C = Degrees Celsius
DO = Dissolved Oxygen
LL = Lower limit, which is 0 for turbidity and D.O.
mg/L = milligrams per liter
mV = Millivolts
NM = Not measured (dry well)
NTU = Nephelometric Turbidity Unit
ORP = Oxidation Reduction Potential
µS/cm^3 = micro Siemens per cubic centimeter
UL = Upper limit, which is 9.1 for D.O.
LL's and UL's are not calculated into the average

Table 6-13
HACH Kit Water Quality Data, AOC 4

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
A Aquifer Wells							
Q4	6/12/06	4-MW-02A	3.3	0.00	0.106	0.00	Fe2+ possibly > than 3.3
Q5	9/14/06		3.3	0.02	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/12/07		2.69	0.02	0.00	0.00	DO "Above Limit"
Q7	5/9/07		3.30	0.01	0.00	2.00	PID = 0; flow = 50ml/min
		AVERAGE	**3.15**	**0.01**	**0.03**	**0.50**	
Q4	6/13/06	4-MW-05A	2.43	0.03	0.00	0.00	NO2 possibly between 0 and 0.002
Q5	9/18/06		0.06	0.01	0.00	0.50	
Q6	2/12/07		NM				
Q7	5/9/07		2.31	0.00	0.00	0.50	PID = 0
		AVERAGE	**1.60**	**0.01**	**0.00**	**0.33**	
Q4	6/12/06	4-MW-06A	0.1	0.30	0.085	0.05	H2O2 may be < 0.05
Q5	9/14/06		0.25	0.30	0.00	0.00	NO2 possibly between 0 and 0.002
Q6	2/12/07		1.99	0.18	0.00	0.00	NO_2 possibly between 0 and 0.002; DO "Above Limit"
Q7	5/9/07		2.63	0.11	0.00	0.50	PID = 0
		AVERAGE	**1.24**	**0.22**	**0.02**	**0.17**	
Q4	6/13/06	4-MW-07A	3.3	0.02	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/13/06		3.3	0.02	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q6	2/12/07		3.3	0.02	0.00	0.00	Fe^{2+} possibly > than 3.3. NO_2 possibly between 0 and 0.002
Q7	5/9/07		3.30	0.01	0.00	2.00	PID = 0; flow = 50ml/min
		AVERAGE	**3.30**	**0.02**	**0.00**	**0.50**	
Q2		4-I17-M01A					
Q3	1/26/06		3.24	0.04	0.00	0.60	
Q4	6/15/06		3.3	0.05	0.0	4.80	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/15/06		0.23	0.07	0.091	0.00	NO2 possibly between 0 and 0.002
Q6	2/13/07		0.03	0.05	0.00	0.50	
Q7	5/7/07		1.51	0.00	0.04	0.00	Hach turbidity, PID = 0
		AVERAGE	**1.66**	**0.04**	**0.03**	**1.18**	
Q4	6/13/06	4-I17-P01A	3.3	0.08	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/14/06		0.72	0.10	0.00	0.50	NO2 possibly between 0 and 0.002
Q6	2/13/07		1.37	0.11	0.00	0.00	NO_2 possibly between 0 and 0.002
Q7	5/9.07		NM				PID = 0
		AVERAGE	**1.80**	**0.10**	**0.00**	**0.17**	
		A AQUIFER AVERAGE	**2.14**	**0.07**	**0.01**	**0.54**	
B Aquifer Wells							
Q4	6/13/06	4-MW-01B	3.3	0.02	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/18/06		3.3	0.01	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/12/07		3.27	0.02	0.00	0.00	NO_2 possibly between 0 and 0.002
Q7	5/9/07		3.30	0.01	0.00	0.00	PID = 0
		AVERAGE	**3.29**	**0.02**	**0.00**	**0.00**	
Q4	5/5/06	4-H17-M02B	2.53	0.37	0.00	0.00	NO2 possibly between 0 and 0.002
Q5	9/14/06		2.36	0.28	0.0	0.28	
Q6	2/13/07		2.01	0.25	0.001	0.00	DO "Above Limit"
Q7	5/7/07		3.30	0.08	0.00	0.00	
		AVERAGE	**2.55**	**0.25**	**0.00**	**0.07**	
		B AQUIFER AVERAGE	**2.92125**	**0.13**	**0.000125**	**0.035**	

Notes:

mg/L = milligrams per liter

NM = not measured (dry well)

Table 6-14
Major Ions in Groundwater, AOC 4

Analyte			CHLORIDE		FLUORIDE		NITRATE/NITRITE AS N		SULFATE (SO_4)		TOTAL ALKALINITY As $CaCO_3$		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		NA		250		NA		NA	
Region 6 Tap Water PRG (mg/L)			NA		2.19		NA		NA		NA		0.00073	
Sample ID	Sample Date	Qtr #	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag
Aquifer A														
4-MW-02-GU-P-02	6/12/06	4	10	J	1.2		0.3		74	J	250		0.12	
	9/14/06	5	12		1.2		0.015		51		230		0.21	
	2/12/07	6	9.4		1.2		0.027		22	0	250		0.097	
	5/9/07	7	8.1		1.5		1	U	19		250		0.05	U
AVERAGE			*9.9*		*1.3*		*0.34*		*41.5*		*245*		*0.12*	
4-MW-05-GU-P-02	6/13/06	4	110	J	2.4		0.026		60	J	780		0.22	
	9/18/06	5	98		2.1		0.66		47		640		0.37	
	2/12/07	6	89		2.1		0.01	U	46		820		0.29	
	5/9/07	7	92		2		1	U	3.7		820		0.24	
AVERAGE			*97*		*2.2*		*0.42*		*39*		*765*		*0.28*	
4-MW-06-GU-P-02	6/12/06	4	52	J	6.3		0.03		1500	J	140		0.067	
	9/14/06	5	50		4.9		0.054		1600		160		0.082	
	2/13/07	6	60		4		0.05	U	1700		250		0.1	
	5/9/07	7	54		4.2		2	U	1600		160		0.05	U
AVERAGE			*54*		*4.9*		*0.53*		*1600*		*178*		*0.075*	
4-MW-07-GU-P-02	6/13/06	4	400	J	0.77		0.26		41	J	500		0.81	
	9/18/06	5	370		0.71		0.029		2.3		440		1.1	
	2/12/07	6	360		0.76	N	0.05	UN	11		570		1.3	
	5/9/07	7	310		0.54		1.2		7		630		0.39	
AVERAGE			*360*		*0.70*		*0.38*		*15*		*535*		*0.9*	
I17-M01A-GU-P-02	11/18/05	2	200	J	9.2		0.051		440		1100		0.11	J
	1/26/06	3	170	J	7.3		0.01	U	460		1300		0.41	J
	5/5/06	4	150	J	7.5		0.016		430		1300		0.52	J
	9/13/06	5	180		8.8		0.048		730		1400		0.31	
	2/13/07	6	54		5.1		0.026		320		540		0.37	
	5/7/07	7	20		3.6		0.029	N	280		290		0.062	
AVERAGE			*129*		*6.9*		*0.03*		*443*		*988*		*0.30*	
I17-P01A-GU-P-02	6/16/06	4	430	J	1.1		0.1	U	2	U	510		0.98	
	9/15/06	5	390		1.2		0.021		2.9		250		0.26	
AVERAGE			*410*		*1.15*		*0.06*		*2.45*		*380*		*0.62*	
A AQUIFER AVERAGE			*153.27*		*3.32*		*0.29*		*393.70*		*565.83*		*0.35*	
B Aquifer														
4-MW-01-GU-P-02	6/13/06	4	440	J	0.59		0.33		50	J	410		0.7	
	9/18/06	5	360		0.61		0.015		6.2		420		0.74	
	2/9/07	6	200		0.48		0.014		2	U	660		1.1	
	5/9/07	7	130		0.59		1	U	1	U	700		0.69	
AVERAGE			*283*		*0.57*		*0.34*		*15*		*548*		*0.81*	
H17-M02B-GU-P-02	6/14/06	4	250	J	0.2	U	0.026		66	J	970		1.2	
	9/14/06	5	240		0.2	U	0.01	U	53		980		1.8	
	2/12/07	6	240		0.5	U	0.16		54		990		1.8	
	5/7/07	7	0.4	U	0.2	U	0.5	U	53		960		1.2	
AVERAGE			*183*		*0.3*		*0.17*		*57*		*975*		*1.5*	
B AQUIFER AVERAGE			*232.55*		*0.42*		*0.26*		*35.65*		*761.25*		*1.15*	

Notes:

$CaCO_3$ = Calcium carbonate
mg/L = milligrams per liter
NA = Not Applicable
N = Nitrogen
PRG = Preliminary Remediation Goal
Qtr = Quarter
WQC = Water Quality Criteria
J = Estimated result
U = Not Detected

Table 6-15
Isotopic and Total Uranium in Groundwater, AOC 4

Analyte		U-234		U-235		U-238		Uranium (Total)		
MCL		N/A		N/A		N/A		30 (µg/L)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
A Aquifer										
4-MW-02-GU-P-02	6/12/06	2.34 J	0.48	0.21 J	0.1	2.64 J	0.53	5.4	8.1 J	1.1
	9/14/06	3.04	0.59	0.182 LT	0.087	3.12	0.6	6.4	9.6	1.2
	2/12/07	3.89	0.77	0.145 LT	0.096	4.22	0.82	8.6	12.9	1.7
	5/9/07	5.8	1.2	0.3	0.16	4.9	1	10	15.0	2.1
	AVERAGE	*3.8*		*0.21*		*3.72*			*11.4*	
4-MW-05-GU-P-02	6/13/06	1.79 J	0.37	0.101 U,J	0.061	1.82 J	0.37	3.73	5.59 J	0.76
	9/18/06	1.84	0.42	0.153 LT	0.096	2.14	0.47	4.38	6.57	0.97
	2/12/07	1.17	0.3	0.065 LT	0.059	1.11	0.29	2.28	3.42	0.59
	5/9/07	0.71	0.23	-0.004 U	0.058	0.44	0.17	0.91	1.36	0.36
	AVERAGE	*1.38*		*0.08*		*1.38*			*4.24*	
4-MW-06-GU-P-02	6/12/06	11 J	1.9	0.39 J	0.15	10.4 J	1.8	21.3	31.9 J	3.7
	9/14/06	9.7	1.7	0.33	0.14	8.3	1.5	16.9	25.3	3
	2/13/07	8.5	1.5	0.25	0.13	5.2	1	10.6	15.9	2
	5/9/07	6.7	1.3	0.3	0.16	5.1	1.1	10.5	15.7	2.1
	AVERAGE	*9.0*		*0.32*		*7.3*			*22.2*	
4-MW-07-GU-P-02	6/13/06	0.17 J	0.11	0.07 U	0.08	0.137 J	0.096	0.28	0.42 J	0.2
	9/18/06	0.087 U	0.08	0.009 U	0.048	0.067 U	0.067	0.14	0.21 U	0.14
	2/12/07	0.156 LT	0.091	0.014 U	0.049	0.136 LT	0.084	0.28	0.42 LT	0.17
	5/9/07	0.092 U	0.088	-0.005 U	0.073	0.001 U	0.062		U	0.13
	AVERAGE	*0.126*		*0.022*		*0.085*			*0.35*	
I17-M01A-GU-P-02	11/18/05	62.5	10	3.12	0.69	62.5	10	128	192	21
	1/26/06	64.1	10	5.2	1	66	11	134	201	22
	5/5/06	56.5 J	10	4.7 J	1.4	59 J	11	122	183 J	22
	9/13/06	51.3	8.6	2.7	0.55	50.3	8.5	103	154	17
	2/13/07	26.6	4.5	1.29	0.35	29.3	5	59.9	90	10
	5/7/07	16.8	3	0.77	0.26	16.3	2.9	33.4	50	5.9
	AVERAGE	*46.3*		*2.96*		*47.2*			*145*	
I17-P01A-GU-P-02	6/16/06	0.085 U,J	0.099	0.027 U,J	0.056	0.058 U,J	0.067	0.12	0.18 U,J	0.14
	9/15/06	0.166 LT	0.094	U	0.049	0.123 LT	0.079	0.25	0.37 LT	0.16
	AVERAGE	*0.126*		*0.027*		*0.091*			*0.28*	
A AQUIFER AVERAGE		*13.96*		*0.88*		*13.89*			*44.48*	
B Aquifer										
4-MW-01-GU-P-02	6/13/06	0.33 U,J	0.11	0.023 U,J	0.028	0.33 U,J	0.11	0.67	1.00 U,J	0.22
	9/18/06	0.07 U	0.071	0.014 U	0.051	0.139 LT	0.086	0.28	0.42 LT	0.18
	2/9/07	0.141 LT	0.06	0.012 U	0.023	0.101 LT	0.049	0.21	0.31 LT	0.1
	5/9/07	0.21	0.14	0.037 U	0.087	0.16 U	0.13	0.32	0.48 U	0.27
	AVERAGE	*0.19*		*0.022*		*0.183*			*0.55*	
H17-M02B-GU-P-02	6/14/06	0.143 J	0.081	0.013 U	0.039	0.035 U	0.048	0.072	0.11 U	0.098
	9/14/06	0.027 U	0.042	0.004 U	0.036	0.053 U	0.053	0.11	0.16 U	0.11
	2/12/07	0.058 U	0.066	-0.021 U	0.05	0.078 U	0.074	0.16	0.24 U	0.15
	5/7/07	0.032 U	0.052	0.029 U	0.061	0.05 U	0.06	0.1	0.15 U	0.12
	AVERAGE	*0.065*		*0.0063*		*0.054*			*0.17*	
B AQUIFER AVERAGE		*0.13*		*0.01*		*0.12*			*0.36*	

Notes:

MCL = Maximum Contaminant Level
NA = Not Applicable
pCi/L = picoCuries per liter
TPU = Total Propagated Uncertainty
µg/L = micrograms per liter
J = Estimated result
LT = Result is less than requested MDC but greater than sample specific MDC
U = Result is less than the sample specific MDC
All samples are unfiltered
Shading indicates detected concentrations that equal or exceed the MCL

pCi/L results are converted to µg/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 6-16
Radiochemical Analysis of Groundwater, AOC 4

Analyte		GROSS ALPHA		GROSS BETA		Ra-226		Ra-228		Th-228		Th-230		Th-232	
MCL		15		N/A		5 (combined Ra226/228)		5 (combined Ra226/228)		N/A		N/A		N/A	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
A Aquifer															
4-MW-02-GU-P-02	6/12/06	5.60	1.1	10.1	1.8	0.17 J	0.13	0.39 U	0.36	0.013 U	0.077	0.054 U	0.056	0.019 U	0.018
	9/14/06	5.10	1	9.2	1.7	0.27 LT	0.16	0.33 U	0.48	0.047 U	0.098	0.09 U	0.068	0.015 U	0.024
	2/12/07	9.50	2.3	8.2	2	0.24 LT	0.17	0.45 U	0.37	U	0.068	0.055 U	0.069	0.015 LT	0.019
	5/9/07	6.40	1.8	8.3	2	0.14 Y1,U	0.12	0.32 U,M	0.53	0.001 U	0.053	0.086 U	0.075	0.021 U	0.024
AVERAGE		***6.65***		***8.95***		***0.21***		***0.37***		***0.02***		***0.07***		***0.02***	
4-MW-05-GU-P-02	6/13/06	4.00	1.5	17.1	3.7	0.23 J	0.15	0.51 U	0.38	-0.011 U	0.095	0.029 U	0.061	-0.004 U	0.018
	9/18/06	1.20 U	1.4	17.6	3.6	0.18 Y1,LT	0.12	0.57 U	0.43	0.001 U	0.059	-0.053 U	0.056	0.012 U	0.024
	2/12/07	2.60 LT	1.2	16.2	3.2	0.3 LT	0.18	0.88 LT	0.45	-0.006 U	0.054	0.042 U	0.065	-0.004 U	0.02
	5/9/07	-2.10 U,M	1.8	17.8 M3	4.4	0.56 U	0.44	0.45 U	0.48	U	0.065	0.051 U	0.069	0.029 U	0.033
AVERAGE		***1.43***		***17.2***		***0.32***		***0.60***		***-0.01***		***0.02***		***0.01***	
4-MW-06-GU-P-02	6/12/06	28.9	5.8	31.4	6.8	0.22 J	0.14	0.35 U	0.34	0.02 U	0.085	0.177 J	0.076	0.04 J	0.028
	9/14/06	7.80 M3	4.1	23.2 M3	8	0.23 LT	0.15	0.44 U	0.5	0.18 LT	0.12	0.077 U	0.074	0.022 U	0.033
	2/13/07	12.5 M3	4.2	28.5 M3	7.8	0.15 U	0.13	0.26 U	0.4	0.029 U	0.044	-0.011 U	0.055	0.019 U	0.022
	5/9/07	10.3 M3	4	25.4 M3	7.6	0.13 U	0.12	0.41 U,M	0.52	-0.06 U	0.048	0.022 U	0.061	-0.017 U	0.02
AVERAGE		**15**		***27.1***		***0.2***		***0.4***		***0.04***		***0.07***		***0.02***	
4-MW-07-GU-P-02	6/13/06	0.80 U	1.1	19.7	3.9	0.09 U	0.096	0.79 J	0.41	0.1 U	0.1	0.143 J	0.076	0.018 U	0.026
	9/18/06	0.76 U	0.81	15.3	3.2	0.32 Y1,LT	0.17	0.61 U	0.49	0.007 U	0.068	-0.046 U	0.052	0.007 U	0.018
	2/12/07	1.70 U	1.2	14.2	3.3	0.51 LT	0.24	0.77 U	0.46	0.058 U	0.074	-0.006 U	0.062	0.009 U	0.019
	5/9/07	1.30 U	1.7	17 M3	4.2	0.2 U	0.3	0.65 U,M	0.53	0.007 U	0.064	0.102 U	0.074	0.013 U	0.023
AVERAGE		***1.14***		***16.55***		***0.28***		***0.71***		***0.04***		***0.05***		***0.01***	
I17-M01A-GU-P-02	11/18/05	68.0 J	12	89 J	15	0.32 J	0.19	0.66 U	0.4						
	1/26/06	92.0	15	86	14	0.51 J	0.23	0.71 J	0.41						
	5/5/06	72.0	12	86	14	0.56 J	0.24	0.53 U	0.43	0.24 U	0.63	0.6 U	0.82	0.59 J	0.36
	9/13/06	77.0 M3	14	98 M3	17	0.81 LT	0.32	0.4 U	0.46	0.017 U	0.069	-0.041 U	0.06	0.008 U	0.02
	2/13/07	56.1	9.6	53.9	9.1	0.39 LT	0.2	-0.17 U	0.38	0.196 LT	0.099	0.26	0.11	0.022 U	0.03
	5/7/07	40.2	7.1	17.9	3.6	0.032 U	0.069	0.44 U,M	0.58	0.039 U	0.083	-0.019 U	0.061	U	0.027
AVERAGE		***67.6***		***71.8***		***0.44***		***0.43***		***0.12***		***0.20***		***0.21***	
I17-P01A-GU-P-02	6/16/06	2.50	1.5	26.8	5.5	0.68 Y1,LT	0.28	1.57	0.64	0.168 LT	0.095	0.029 U	0.056	0.039 LT	0.027
	9/15/06	9.90 M3	3	29.9 M3	6.1	0.82 LT	0.33	1.83	0.67	0.255	0.099	0.064 U	0.067	0.046 LT	0.032
AVERAGE		***6.20***		***28.4***		***0.75***		***1.70***		***0.21***		***0.05***		***0.04***	
A AQUIFER AVERAGE		***21.42***		***31.9***		***0.34***		***0.59***		***0.07***		***0.08***		***0.04***	

Table 6-16
Radiochemical Analysis of Groundwater, AOC 4
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		Ra-226		Ra-228		Th-228		Th-230		Th-232	
MCL		15		N/A		5 (combined Ra226/228)		5 (combined Ra226/228)		N/A		N/A		N/A	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
B Aquifer															
4-MW-01-GU-P-02	6/13/06	1.60 U	1.3	17	3.8	0.22 J	0.14	0.79 J	0.42	-0.004 U	0.096	0.07 U	0.064	0.046 J	0.028
	9/18/06	-0.40 U	1.4	14.2	3.1	0.22 Y1,LT	0.14	0.48 U	0.43	-0.002 U	0.077	-0.023 U	0.057	0.02 LT	0.02
	2/9/07	2.90 LT	1.2	17.3	3.5	0.31 LT	0.18	1.77 M3	0.8	0.021 U	0.071	-0.012 U	0.059	0.008 U	0.022
	5/9/07	0.70 U	1.6	16.7 M3	4.3	0.16 LT	0.13	0.42 U,M	0.52	-0.001 U	0.061	0.043 U	0.064	0.003 U	0.02
AVERAGE		***1.20***		***16.30***		***0.23***		***0.87***		***0.004***		***0.020***		***0.019***	
H17-M02B-GU-P-02	6/14/06	1.50 U	1.5	8.9	3.5	0.42 J	0.21	0.92 J	0.45	-0.033 U	0.069	0.052 U	0.063	0.004 U	0.021
	9/14/06	3.50 M3	2.2	7.9 M3	3.8	0.71 LT	0.29	1.17	0.55	0.036 U	0.096	0.06 U	0.062	-0.005 U	0.018
	2/12/07	3.20	1.9	8 M3	3	1.81	0.6	0.63 U	0.41	0.026 U	0.063	0.133 LT	0.08	0.018 U	0.02
	5/7/07	1.80 U,M	2.1	12.4 M3	4.6	0.78 LT	0.32	0.67 U,M	0.6	0.087 U	0.091	-0.042 U	0.059	0.034 U	0.038
AVERAGE		***2.50***		***9.30***		***0.93***		***0.85***		***0.029***		***0.051***		***0.013***	
B AQUIFER AVERAGE		**1.85**		***12.8***		***0.58***		***0.86***		***0.02***		***0.04***		***0.02***	

Notes:

MCL = Maximum Concentration Level
NA = Not Applicable
pCi/L = picoCuries per liter
TPU = Total Propagated Uncertainty
J = Estimated result
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC.
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits
All samples are unfiltered
Shading indicates detected concentrations that equal or exceed the MCL

Table 6-17
Metals Exceeding Preliminary Remediation Goals in Groundwater, AOC 4

Analyte		ANTIMONY		ARSENIC		CHROMIUM		IRON		LEAD		MANGANESE	
NJDEP WQC (mg/L)		0.006		0.003		0.07		0.3		0.005		0.05	
Region 6 Tap Water PRG (mg/L)		0.0146		4.4821E-05		0.11		25.55		0.015		1.70309	
Sample ID	Sample Date	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag
A Aquifer													
4-MW-02-GU-P-02	6/12/06							33	J			2	
	9/14/06							27					
	2/12/07							30					
	5/9/07							35					
AVERAGE		*N/A*		*N/A*		*N/A*		***31.25***		*N/A*		*N/A*	
4-MW-06-GU-P-02	6/12/06	0.83								0.03			
	9/14/06	0.74		0.01						0.24			
	2/13/07	0.051											
	5/9/07	0.034						40					
AVERAGE		***0.41375***		*N/A*		*N/A*		*N/A*		***0.135***		*N/A*	
4-MW-07-GU-P-02	6/13/06							77	J			2.6	
	9/18/06			0.011				62				2.4	
	2/12/07							100				3.5	
	5/9/07			0.011				96				3.3	
AVERAGE		*N/A*		***0.011***		*N/A*		***83.75***		*N/A*		***2.95***	
I17-M01A-GU-P-02	11/18/05	0.021											
	2/13/07	0.027						28		0.32			
AVERAGE		***0.024***		*N/A*		*N/A*		*N/A*		*N/A*		*N/A*	
I17-P01A-GU-P-02	6/16/06	0.021		0.031		0.18		390	J			2.7	
	9/15/06			0.022		0.12		240				2.2	
AVERAGE		***0.021***		***0.0265***		***0.15***		***315***		*N/A*		***2.45***	
A AQUIFER AVERAGE		***0.25***		***0.02***		***0.15***		***96.50***		***0.20***		***2.67***	
B Aquifer													
4-MW-01-GU-P-02	6/13/06							58	J			1.8	
	9/18/06							46					
	2/9/07							76				1.9	
	5/9/07							59					
AVERAGE		*N/A*		*N/A*		*N/A*		***59.75***		*N/A*		***1.85***	
H17-M02B-GU-P-02	6/14/06			0.014									
	2/12/07			0.013									
	5/7/07			0.015									
AVERAGE		*N/A*		***0.014***		*N/A*		*N/A*		*N/A*		*N/A*	
B AQUIFER AVERAGE		*N/A*		***0.014***		*N/A*		***59.75***		*N/A*		***1.85***	

Notes:

mg/L = milligrams per liter
NA = Not Applicable
PRG = Preliminary Remediation Goal
WQC = Water Quality Criteria
J = Estimated result
All samples unfiltered

Table 6-18
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, AOC 4

		SVOA											
		1,2,4-TRICHLOROBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	2-CHLOROPHENOL	3,3'-DICHLOROBENZIDINE	4-CHLOROANILINE	ANILINE	AZOBENZENE	CARBAZOLE	NAPHTHALENE	N-NITROSODIPHENYLAMINE
NJDEP WQC (µg/L)		9	600	600	75	40	30	30	6	NA	NA	300	10
Region 6 PRG (µg/L)		**8.16**	**49.3**	**14.5**	**0.467**	**30.4**	**0.149**	**146**	**11.8**	**0.611**	**3.36**	**6.2**	**13.7**
Sample ID	**Sample Date**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**
A Aquifer													
4-MW-01-GU-P-02	**2/12/07**				3.6 J								
4-MW-02-GU-P-02	**2/12/07**				1.4 J								
4-MW-05-GU-P-02	**2/12/07**				4.7 J							25	
4-MW-06-GU-P-02	**2/13/07**	130	9200	140	1600		15 J	11000	42000	4.5 J	34	3600	37
I17-M01A-GU-P-02	**2/13/07**	36	600	19 J	68		62		65		8.3 J	15 J	
A AQUIFER AVERAGE		**83.00**	**4900.00**	**79.50**	**335.54**	**N/A**	**38.50**	**11000.00**	**21032.50**	**N/A**	**21.15**	**1213.33**	**N/A**
B Aquifer													
H17-M02B-GU-P-02	**2/12/07**		690	18 J	200	52 J	22 J	49000	170000			160	

Table 6-18
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, AOC 4
(cont.)

		VOA										
		1,2,4-TRICHLOROBENZENE	1,2,4-TRIMETHYLBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	BENZENE	BROMOBENZENE	CHLOROBENZENE	CIS-1,2-DICHLOROETHENE	NAPHTHALENE	TETRACHLOROETHENE
NJDEP WQC (µg/L)		9	NA	600	600	75	1	NA	50	70	300	1
Region 6 PRG (µg/L)		**8.16**	**12.4**	**49.3**	**14.5**	**0.467**	**0.354**	**23.3**	**91.3**	**60.8**	**6.2**	**0.105**
Sample ID	**Sample Date**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**	**Result (µg/L) Flag**
A Aquifer												
4-MW-01-GU-P-02	**2/12/07**					6.8						
4-MW-02-GU-P-02	**2/12/07**					2.3 J					12	
4-MW-05-GU-P-02	**2/12/07**										33	
4-MW-06-GU-P-02	**2/13/07**	210 J		10000	250 J	1600	540		5200	260 J	3800	380 J
I17-M01A-GU-P-02	**2/13/07**	50	56	770	20 J	86	790	25 J	310		18 J	
A AQUIFER AVERAGE		**130**	**56**	**5385**	**135**	**423.775**	**665**	**25**	**2755**	**260**	**965.75**	**380**
B Aquifer												
H17-M02B-GU-P-02	**2/12/07**			570		180 J	5800		3800		120 J	

Notes:

µg/L = micrograms per liter
NA = Not Applicable
PRG = Preliminary Remediation Goal
WQC = Water Quality Criteria
J = Estimated result
All samples unfiltered

Table 6-19
Soil Boring FIDLER Scan Results, AOC 6, AOI 4

Table 6-19a
Soil Boring FIDLER Scan Results
OU 3 AOC 6 AOI 4

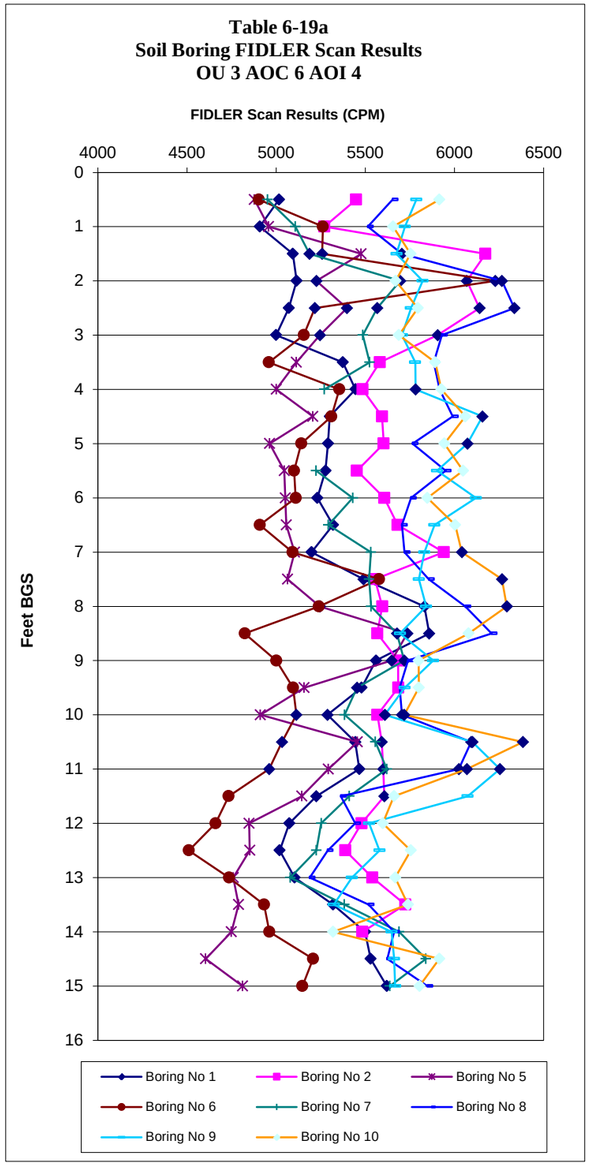

Table6-19b
Soil Boring FIDLER Scan Results,
OU 3 AOC 6 AOI 4

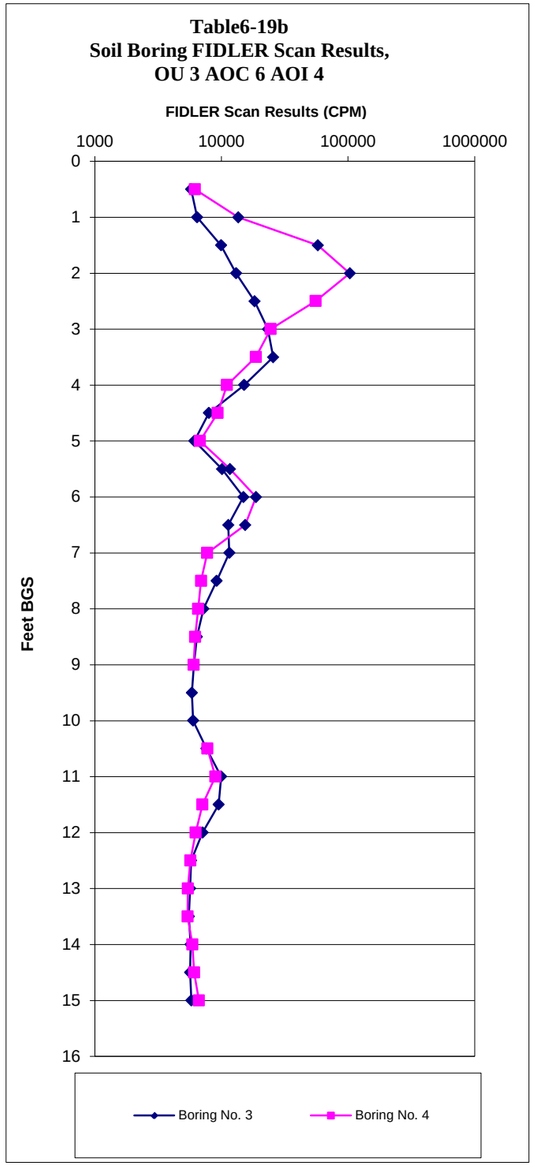

Table 6-19c
Soil Boring FIDLER Scan Results,
OU 3 AOC 6 AOI 4

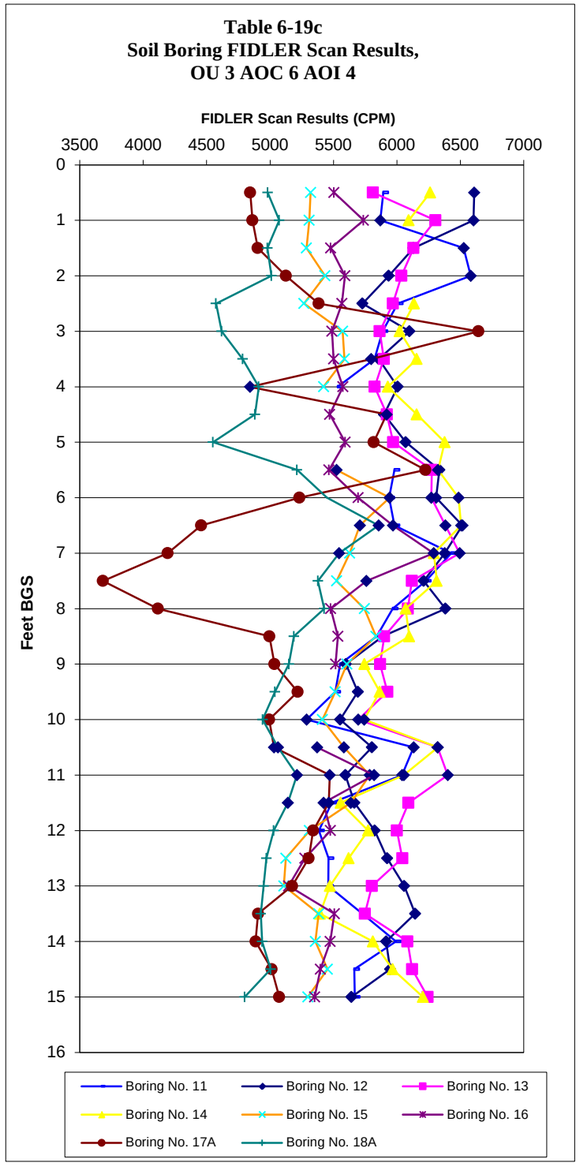

Table 6-19d
Soil Boring FIDLER Scan Results
OU 3 AOC 6 AOI 4

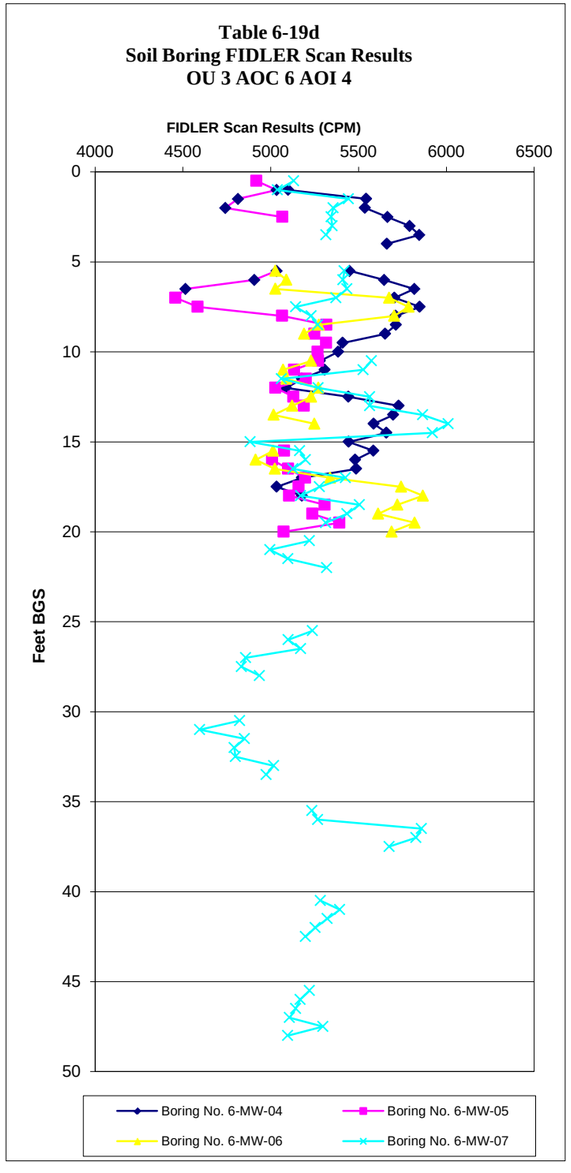

Table 6-20
Soil Boring FIDLER Scan Results
OU3 AOC 6 AOI 6

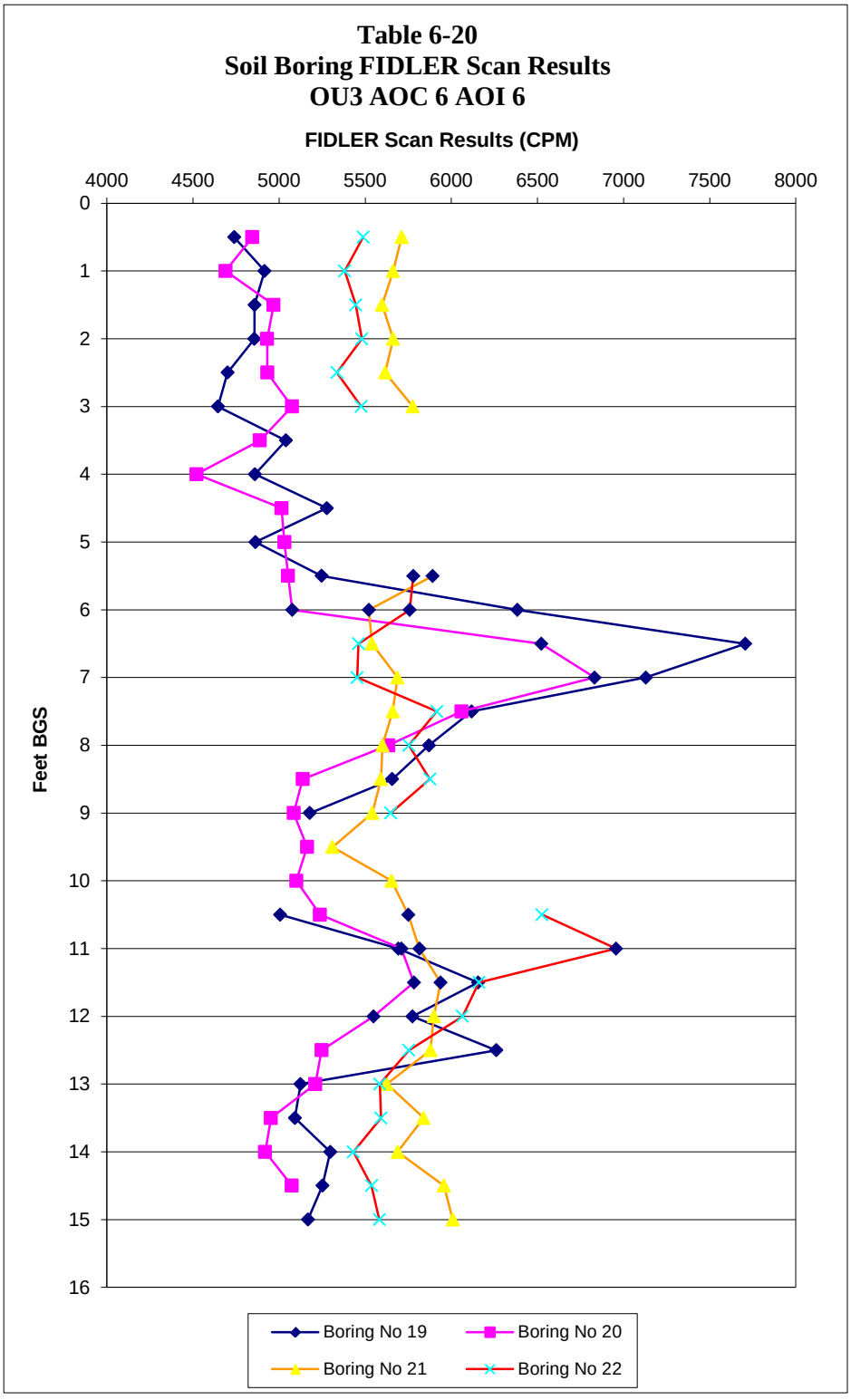

Table 6-21
Total Uranium Results for Soil and Concrete Samples, AOC 6

					Offsite Gamma Spectroscopy		
					Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
6CPT-05	6CPT-05-B-P-8.5	11/15/04	8.5	9.5	-1.7 U	2.9	5.2
6CPT-21	6CPT-21-B-P-2	11/15/04	2	3	**69**	10	6
6CPT-25	6CPT-25-B-P-5	11/15/04	5	6	1.2 U	2.3	3.8
6CPT-37	6CPT-37-B-P-8	11/15/04	8	9	**153**	24	17
6CPT-45	6CPT-45-B-P-2.5	11/16/04	2.5	3.5	5.8	3.5	5.4
6CPT-54	6CPT-54-B-P-11	11/16/04	11	12	2.6 U	3.2	5.3
6CPT-62A	6CPT-62A-B-P-0.5	10/25/04	0.5	1.5	**1280**	150	20
6-MW-01	6-MW-01-B-P-07	11/29/05	6.5	7.5	0 U	1.7	2.9
6-MW-01	6-MW-01-B-P-19	11/29/05	19	20	-0.5 U	1.5	2.7
6-MW-02	6-MW-02-B-P-08	11/29/05	8	9	0.6 U	1.4	2.4
6-MW-02	6-MW-02-B-P-18	11/29/05	18	19	-0.7 U	1.8	3.3
6-MW-03	6-MW-03-B-P-07	11/30/05	7	8	1.4 U	2.1	3.6
6-MW-03	6-MW-03-B-P-17	11/30/05	17	18	0.9 U	1.9	3.3
6-MW-04	6-MW-04-B-P-07	05/10/06	7	7.5	3.2 U	2.8	4.5
6-MW-04	6-MW-04-B-P-13	05/10/06	12.5	13	1.2 U	2.5	4.2
6-MW-05	6-MW-05-B-P-08	05/10/06	8	8.5	0.8 U	2.2	3.8
6-MW-05	6-MW-05-B-P-12	05/10/06	11.5	12	-2.5 U	3.7	7.1
6-MW-06	6-MW-06-B-P-18	05/10/06	17.5	18	2.1 U	2.5	4.1
6-MW-06	6-MW-06-B-P-19	05/10/06	19	19.5	3.2 U	4.8	8
6-MW-07	6-MW-07-B-P-17	05/09/06	16.5	17	1.3 U	1.4	2.2
6-MW-07	6-MW-07-B-P-25	05/09/06	25	25.5	-1.7 U	3.7	6.9
6-SB-01	6-SB-01-B-P-08	11/12/05	7.5	8.5	2.7 U	3.8	6.3
6-SB-01	6-SB-01-B-P-10	11/12/05	10	11	0.3 U	2.1	3.6
6-SB-02	6-SB-02-B-P-02	11/12/05	2	3	**25.6**	8.3	10.7
6-SB-02	6-SB-02-B-P-11	11/12/05	10.5	11.5	3.7	2.2	3.3
6-SB-03	6-SB-03-B-P-03	11/12/05	2.5	3.5	**386**	47	10
6-SB-03	6-SB-03-B-P-06	11/12/05	5.5	6.5	**318**	39	10
6-SB-04	6-SB-04-B-P-01	11/12/05	1	2	**3910**	460	40
6-SB-04	6-SB-04-B-P-06	11/12/05	5.5	6.5	**162**	27	22
6-SB-05	6-SB-05-B-P-02	11/11/05	2	3	3.5 U	4.3	7.1
6-SB-05	6-SB-05-B-P-08	11/11/05	8	9	1.6 U	2.3	3.7
6-SB-06	6-SB-06-B-P-02	11/11/05	1.5	2.5	**35.1**	5.9	4.6
6-SB-06	6-SB-06-B-P-10	11/11/05	10	11	3.9 U	4.6	7.5
6-SB-07	6-SB-07-B-P-02	11/12/05	1.5	2.5	2.8 U	2	3.1
6-SB-07	6-SB-07-B-P-09	11/11/05	8.5	9.5	1.2 U	1.7	2.9
6-SB-08	6-SB-08-B-P-02	11/11/05	1.5	2.5	**15.7**	3.7	4.2
6-SB-08	6-SB-08-B-P-10	11/11/05	10	11	2.2 U	3.1	5.2
6-SB-09	6-SB-09-B-P-04	11/11/05	4	5	1.9 U	2	3.2
6-SB-09	6-SB-09-B-P-10	11/11/05	10	11	3.7 U	3.4	5.4
6-SB-10	6-SB-10-B-P-01	11/11/05	7	8	2.6 U	2.2	3.5
6-SB-10	6-SB-10-B-P-10	11/11/05	10	11	1.6 U	2.2	3.6
6-SB-11	6-SB-11-B-P-01	11/11/05	1	2	**29.7**	5.4	4.7
6-SB-11	6-SB-11-B-P-10	11/11/05	10	11	2.9 U	2.1	3.3
6-SB-12	6-SB-12-B-P-00	11/12/05	0	1	**32.2**	5.8	5
6-SB-12	6-SB-12-B-P-06	11/12/05	6	7	1.1 U	2.1	3.5
6-SB-13	6-SB-13-B-P-06	11/12/05	6	7	2 U	2.1	3.4
6-SB-13	6-SB-13-B-P-10	11/12/05	10	11	1.3 U	2.1	3.5
6-SB-14	6-SB-14-B-P-06	11/12/05	5.5	6.5	9.5	2.6	3.2
6-SB-14	6-SB-14-B-P-10	11/12/05	10	11	5.7	2.7	3.9
6-SB-15	6-SB-15-B-P-06	11/13/05	5.5	6.5	2.7 U	1.9	3
6-SB-15	6-SB-15-B-P-11	11/13/05	10.5	11.5	2.3 U	2.5	4.1

Table 6-21
Total Uranium Results for Soil and Concrete Samples, AOC 6
(cont.)

					Offsite Gamma Spectroscopy		
					Uranium (Total)		
Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
6-SB-16	6-SB-16-B-P-07	11/13/05	6.5	7.5	2.2 U	2.9	4.7
6-SB-16	6-SB-16-B-P-11	11/13/05	10.5	11.5	1.4 U	1.8	3
6-SB-17A	6-SB-17A-B-P-04	11/13/05	3.5	4.5	**53.1**	8.4	5.9
6-SB-17A	6-SB-17A-B-P-11	11/13/05	10.5	11.5	10.6	3	3.4
6-SB-17	6-SB-17-B-P-02	11/16/05	2	3	**106**	14	6
6-SB-17	6-SB-17-B-P-05	11/16/05	4.5	5.5	0.4 U	1.9	3.4
6-SB-18A	6-SB-18A-B-P-06	11/13/05	6	7	1.8 U	3.3	5.5
6-SB-18A	6-SB-18A-B-P-11	11/13/05	10.5	11.5	1.5 U	1.6	2.6
6-SB-18	6-SB-18-B-P-03	11/16/05	2.5	3.5	**63.3**	9.2	5.8
6-SB-18	6-SB-18-B-P-05	11/16/05	4.5	5.5	1.2 U	2.4	4.1
6-SB-19	6-SB-19-B-P-06	11/10/05	6	7	**71.3**	9.8	5
6-SB-19	6-SB-19-B-P-11	11/10/05	11	12	**37.3**	6.1	4.9
6-SB-20	6-SB-20-B-P-06	11/10/05	6	7	**101**	14	6
6-SB-20	6-SB-20-B-P-11	11/10/05	10.5	11.5	3.9 U	2.9	4.6
6-SB-21	6-SB-21-B-P-05	11/10/05	5	6	0 U	1.4	2.4
6-SB-21	6-SB-21-B-P-11	11/10/05	10.5	11.5	0.7 U	1.2	2.1
6-SB-22	6-SB-22-B-P-05	11/10/05	5	6	1.2 U	2.1	3.5
6-SB-22	6-SB-22-B-P-10	11/10/05	10	11	**72**	10	5.9
6-SB-31	6-SB-31-B-P-03	11/12/05	2.5	3.5	**52.8**	8	5.6
6-SB-31	6-SB-31-B-P-10	11/12/05	10	11	5.1	2.7	4
					Offsite Alpha Spectroscopy		
					Uranium (Total)		
6-SB-32	6-SB-32-SS-P-00	7/4/07	0	1	1.62	0.33	0.04
6-SB-32	6-SB-32-BS-P-04	7/4/07	4	5	1.05	0.24	0.04
6-SB-33	6-SB-33-SS-P-00	7/4/07	0	1	9.5	1.6	0
6-SB-33	6-SB-33-BS-P-03	7/4/07	3	4	1.34	0.3	0.05
6-SB-34	6-SB-34-SS-P-00	7/4/07	0	1	**35.3**	5.6	0
6-SB-34	6-SB-34-BS-P-03	7/4/07	3	4	1.26 Y2	0.37	0.12
6-SB-35	6-SB-35-SS-P-00	7/4/07	0	1	**56.9**	9	0.1
6-SB-35	6-SB-35-BS-P-03	7/4/07	3	4	1.65	0.34	0.04
6-SB-36	6-SB-36-SS-P-00	7/4/07	0	1	**17.6**	2.9	0.1
6-SB-36	6-SB-36-BS-P-02	7/4/07	2	3	**151 Y2**	27	0
6-SB-37	6-SB-37-SS-P-00	7/4/07	0	1	**116 Y2**	20	0
6-SB-37	6-SB-37-BS-P-01	7/4/07	1	2	**124 Y2**	22	0
6-SB-38	6-SB-38-SS-P-00	7/4/07	0	1	**3740 Y2,M3**	720	10
6-SB-38	6-SB-38-BS-P-01	7/4/07	1	2	**750 Y2,M3**	130	0
6-SB-39	6-SB-39-SS-P-00	7/4/07	0	1	11.2	1.9	0
6-SB-39	6-SB-39-BS-P-01	7/4/07	1	2	4.85	0.87	0.02
6-SB-40	6-SB-40-SS-P-00	7/4/07	0	1	5.16	0.94	0.05
6-SB-40	6-SB-40-BS-P-05	7/4/07	5	6	1.48	0.36	0.14
6-SB-41	6-SB-41-SS-P-00	7/4/07	0	1	3.64	0.73	0.07
6-SB-41	6-SB-41-BS-P-05	7/4/07	5	6	3.95	0.77	0.03

Notes:

ft bgs = Feet below ground surface

MDC = Minimum Detectable Concentration

pCi/g = picoCuries per gram

TPU = Total Propagated Uncertainty

M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC

U = Result is less than the sample specific MDC

Y2 = Chemical yield outside default limits

Samples in **bold** represent results exceeding 14 pCi/g

Table 6-22
Radiological Isotopic Results for Soil Samples, AOC 6

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Ra-226 Gamma Spec				Th-230 Alpha Spec				Th-234 Gamma Spec				U-234 Alpha Spec				U-235 Alpha Spec				U-235 Gamma Spec				U-238 Alpha Spec			
					Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
6-CPT-05	6CPT-05-B-P-8.5	11/15/04	8.5	9.5	0.74		0.14	0.22					-0.8	U	1.4	2.5									0.15	U	0.48	0.81				
6-CPT-21	6CPT-21-B-P-2	11/15/04	2	3	0.85		0.11	0.1					33.6		4.9	3									1.3		0.41	0.76				
6-CPT-25	6CPT-25-B-P-5	11/15/04	5	6	1.59		0.37	0.58					0.6	U	1.1	1.8									0.11	U	0.13	0.2				
6-CPT-37	6CPT-37-B-P-8	11/15/04	8	9	1.01		0.14	0.16					75		12	8									4.03		0.7	0.77				
6-CPT-45	6CPT-45-B-P-2.5	11/16/04	2.5	3.5	2.5		0.37	0.38					2.8		1.7	2.7									-0.17	U	0.43	0.78				
6-CPT-54	6CPT-54-B-P-11	11/16/04	11	12	1.48		0.33	0.55					1.3	U	1.6	2.6									0.25	U	0.21	0.34				
6CPT-62A	6CPT-62A-B-P-0.5	10/25/04	0.5	1.5	1.7		0.42	0.68					624		74	11									39.6		4.9	2.5				
6-MW-01	6-MW-01-B-P-07	11/29/05	6.5	7.5	0.89		0.24	0.41					0	U	0.83	1.44									-0.16	U	0.31	0.55				
	6-MW-01-B-P-19	11/29/05	19	20	0.29	U	0.21	0.39					-0.23	U	0.74	1.34									-0.08	U	0.26	0.48				
6-MW-02	6-MW-02-B-P-08	11/29/05	8	9	0.69		0.22	0.43					0.29	U	0.68	1.15									0.08	U	0.28	0.49				
	6-MW-02-B-P-18	11/29/05	18	19	0.87		0.26	0.43					-0.33	U	0.88	1.59									0.14	U	0.33	0.56				
6-MW-03	6-MW-03-B-P-07	11/30/05	7	8	1.62		0.35	0.47					0.7	U	1	1.7									0.05	U	0.39	0.67				
	6-MW-03-B-P-17	11/30/05	17	18	0.96		0.26	0.43					0.46	U	0.95	1.6									0.04	U	0.32	0.56				
6-MW-04	6-MW-04-B-P-07	5/10/06	7	7.5	1.11		0.26	0.37	0.83		0.19	0.09	1.6	U	1.4	2.2									-0.14	U	0.36	0.66				
	6-MW-04-B-P-13	5/10/06	12.5	13	1.58		0.32	0.49	1.04		0.22	0.09	0.6	U	1.2	2.1									-0.22	U	0.39	0.72				
6-MW-05	6-MW-05-B-P-08	5/10/06	8	8.5	1.03		0.23	0.37	0.54		0.15	0.1	0.4	U	1.1	1.9									0.03	U	0.34	0.6				
	6-MW-05-B-P-12	5/10/06	11.5	12	0.46	U	0.22	0.36	0.30		0.09	0.08	-1.2	U	1.8	3.4									0.04	U	0.24	0.42				
6-MW-06	6-MW-06-B-P-18	5/10/06	17.5	18	0.99		0.27	0.4	0.78		0.17	0.08	1	U	1.2	2									-0.15	U	0.39	0.7				
	6-MW-06-B-P-19	5/10/06	19	19.5	1.16		0.3	0.47	0.76		0.17	0.08	1.6	U	2.4	3.9									-0.13	U	0.22	0.38				
6-MW-07	6-MW-07-B-P-17	5/9/06	16.5	17	0.73		0.22	0.36	0.17		0.07	0.09	0.64	U	0.66	1.06									-0.08	U	0.24	0.45				
	6-MW-07-B-P-25	5/9/06	25	25.5	0.45		0.18	0.26	0.27		0.1	0.11	-0.8	U	1.8	3.4									0	U	0.22	0.39				
6-SB-01	6-SB-01-B-P-08	11/12/05	7.5	8.5	1.46		0.31	0.44					1.3	U	1.9	3.1									-0.24	U	0.38	0.71				
	6-SB-01-B-P-10	11/12/05	10	11	0.99		0.27	0.51					0.1	U	1	1.7									-0.09	U	0.33	0.6				
6-SB-02	6-SB-02-B-P-02	11/12/05	2	3	1.01		0.26	0.39					12.5		4.1	5.2									0.82		0.43	0.62				
	6-SB-02-B-P-11	11/12/05	10.5	11.5	0.85		0.25	0.49					1.8		1.1	1.6									0.08	U	0.28	0.48				
6-SB-03	6-SB-03-B-P-03	11/12/05	2.5	3.5	0.81		0.27	0.56					189		23	5									10.1		1.4	1				
	6-SB-03-B-P-06	11/12/05	5.5	6.5	0.72		0.26	0.57					155		19	5									8.8		1.3	1.2				
6-SB-04	6-SB-04-B-P-01	11/12/05	1	2	14.3		1.8	1					1910		220	20									121		14	4				
	6-SB-04-B-P-06	11/12/05	5.5	6.5	0.79		0.25	0.53					79		13	11									3.99		0.7	0.9				
6-SB-05	6-SB-05-B-P-02	11/11/05	2	3	0.84		0.21	0.41					1.7	U	2.1	3.5									0.1	U	0.23	0.39				
	6-SB-05-B-P-08	11/11/05	8	9	1.03		0.25	0.36					0.8	U	1.1	1.8									-0.1	U	0.31	0.56				
6-SB-06	6-SB-06-B-P-02	11/11/05	1.5	2.5	0.83		0.28	0.47					17.2		2.9	2.2									1.29		0.42	0.61				
	6-SB-06-B-P-10	11/11/05	10	11	0.97		0.25	0.35					1.9	U	2.2	3.7									0.21	U	0.29	0.47				
6-SB-07	6-SB-07-B-P-02	11/12/05	1.5	2.5	0.95		0.25	0.36					1.37	U	0.97	1.5									0.3	U	0.32	0.52				
	6-SB-07-B-P-09	11/11/05	8.5	9.5	0.53		0.19	0.38					0.6	U	0.85	1.4									-0.18	U	0.26	0.5				
6-SB-08	6-SB-08-B-P-02	11/11/05	1.5	2.5	1.05		0.26	0.4					7.7		1.8	2									0.44	U	0.38	0.61				
	6-SB-08-B-P-10	11/11/05	10	11	1.16		0.27	0.46					1.1	U	1.5	2.5									-0.42	U	0.33	0.63				
6-SB-09	6-SB-09-B-P-04	11/11/05	4	5	1.99		0.41	0.6					0.92	U	0.98	1.58									-0.12	U	0.41	0.73				
	6-SB-09-B-P-10	11/11/05	10	11	1.17		0.29	0.48					1.8	U	1.7	2.7									0.07	U	0.35	0.6				
6-SB-10	6-SB-10-B-P-01	11/11/05	7	8	1.46		0.35	0.5					1.3	U	1.1	1.7									-0.13	U	0.35	0.63				
	6-SB-10-B-P-10	11/11/05	10	11	1.27		0.32	0.53					0.8	U	1.1	1.7									0.17	U	0.33	0.55				
6-SB-11	6-SB-11-B-P-01	11/11/05	1	2	0.89		0.3	0.56					14.5		2.6	2.3									0.92		0.43	0.72				
	6-SB-11-B-P-10	11/11/05	10	11	1.46		0.34	0.5					1.4	U	1	1.6									-0.14	U	0.31	0.56				
6-SB-12	6-SB-12-B-P-00	11/12/05	0	1	0.42	U	0.18	0.44					15.7		2.8	2.4									0.82		0.41	0.7				
	6-SB-12-B-P-06	11/12/05	6	7	1.37		0.34	0.56					0.5	U	1	1.7									0.07	U	0.38	0.67				
6-SB-13	6-SB-13-B-P-06	11/12/05	6	7	1.28		0.3	0.46					1	U	1	1.7									-0.08	U	0.31	0.56				
	6-SB-13-B-P-10	11/12/05	10	11	0.82		0.26	0.46					0.6	U	1	1.7									0.07	U	0.26	0.53				
6-SB-14	6-SB-14-B-P-06	11/12/05	5.5	6.5	0.62		0.25	0.45					4.6		1.3	1.6									0.34	U	0.28	0.43				
	6-SB-14-B-P-10	11/12/05	10	11	1.03		0.26	0.36					2.8		1.3	1.9									-0.08	U	0.32	0.57				
6-SB-15	6-SB-15-B-P-06	11/13/05	5.5	6.5	0.71		0.24	0.37					1.34	U	0.94	1.46									0.41	U	0.3	0.46				
	6-SB-15-B-P-11	11/13/05	10.5	11.5	0.68		0.24	0.47					1.1	U	1.2	2									0.22	U	0.31	0.51				
6-SB-16	6-SB-16-B-P-07	11/13/05	6.5	7.5	1.47		0.32	0.5					1.1	U	1.4	2.3									0.01	U	0.35	0.61				
	6-SB-16-B-P-11	11/13/05	10.5	11.5	0.95		0.23	0.41					0.69	U	0.9	1.47									0.26	U	0.33	0.54				

Table 6-22
Radiological Isotopic Results for Soil Samples, AOC 6
(cont.)

Sample Location	Sample ID	Sample Date	Start Depth (ft bgs)	End Depth (ft bgs)	Ra-226 Gamma Spec				Th-230 Alpha Spec				Th-234 Gamma Spec				U-234 Alpha Spec				U-235 Alpha Spec				U-235 Gamma Spec				U-238 Alpha Spec			
					Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
6-SB-17	6-SB-17-B-P-02	11/13/05	2	3	0.99		0.39	0.63					51.7		6.9	3.1									2.88		0.59	0.7				
	6-SB-17-B-P-05	11/13/05	4.5	5.5	0.26	U	0.3	0.48					0.2	U	0.95	1.66									0.29	U	0.32	0.52				
6-SB-17	6-SB-17A-B-P-04	11/16/05	3.5	4.5	0.88		0.31	0.56					26		4.1	2.9									1.32		0.44	0.77				
	6-SB-17A-B-P-11	11/16/05	10.5	11.5	0.41		0.19	0.4					5.2		1.4	1.7									0.06	U	0.32	0.57				
6-SB-18	6-SB-18-B-P-03	11/16/05	2.5	3.5	1.58		0.38	0.66					31		4.5	2.8									2.21		0.55	0.88				
	6-SB-18-B-P-05	11/16/05	4.5	5.5	1.04		0.31	0.5					0.6	U	1.2	2									0.29	U	0.34	0.55				
6-SB-18A	6-SB-18A-B-P-06	11/13/05	6	7	1.13		0.25	0.43					0.9	U	1.6	2.7									0.17	U	0.17	0.28				
	6-SB-18A-B-P-11	11/13/05	10.5	11.5	0.39	U	0.23	0.49					0.73	U	0.79	1.27									0.02	U	0.26	0.47				
6-SB-19	6-SB-19-B-P-06	11/10/05	6	7	0.74		0.28	0.46					34.9		4.8	2.5									2.93		0.56	0.72				
	6-SB-19-B-P-11	11/10/05	11	12	0.73		0.2	0.39					18.2		3	2.4									0.89		0.33	0.57				
6-SB-20	6-SB-20-B-P-06	11/10/05	6	7	1.05		0.31	0.59					49.5		6.7	3.1									3.92		0.71	0.78				
	6-SB-20-B-P-11	11/10/05	10.5	11.5	1.35		0.29	0.4					1.9	U	1.4	2.3									0.14	U	0.39	0.66				
6-SB-21	6-SB-21-B-P-05	11/10/05	5	6	0.47		0.24	0.4					-0.02	U	0.67	1.19									0.02	U	0.25	0.44				
	6-SB-21-B-P-11	11/10/05	10.5	11.5	0.56		0.22	0.37					0.34	U	0.6	1.01									-0.05	U	0.27	0.48				
6-SB-22	6-SB-22-B-P-05	11/10/05	5	6	0.45		0.18	0.34					0.6	U	1	1.7									0.01	U	0.29	0.51				
	6-SB-22-B-P-10	11/10/05	10	11	0.86		0.33	0.55					35.2		5.1	2.9									1.95		0.49	0.75				
6-SB-31	6-SB-31-B-P-03	11/12/05	2.5	3.5	0.92		0.26	0.43					25.8		3.9	2.7									1.74		0.52	0.83				
	6-SB-31-B-P-10	11/12/05	10	11	0.94		0.26	0.43					2.5		1.3	2									0.03	U	0.34	0.59				
6-SB-32	6-SB-32-SS-P-00	7/4/07	0	1	0.74	G	0.19	0.3	0.54	M3	0.15	0.13	5	U,M,G	4.1	6.3	0.76		0.16	0.03	0.06	LT	0.03	0.02	0.24	U,G	0.3	0.5	0.79		0.16	0.02
	6-SB-32-BS-P-04	7/4/07	4	5	0.9	G	0.24	0.36	0.36	M3	0.12	0.13	-3.8	U,M,G	5.2	9.7	0.56		0.12	0.02	0.04	LT	0.03	0.01	0.43	U,G	0.41	0.65	0.51		0.12	0.02
6-SB-33	6-SB-33-SS-P-00	7/4/07	0	1	0.63	G	0.18	0.3	0.75	M3	0.18	0.12	3.3	U,M,G	4.6	7.6	4.39		0.72	0.02	0.24		0.07	0.02	0.23	U,G	0.36	0.59	4.66		0.76	0.02
	6-SB-33-BS-P-03	7/4/07	3	4	0.93	G	0.23	0.4	0.61	M3	0.15	0.11	3.5	U,M,G	3.5	5.7	0.61		0.14	0.02	0.04	LT	0.03	0.03	0.35	U,G	0.39	0.63	0.65		0.15	0.02
6-SB-34	6-SB-34-SS-P-00	7/4/07	0	1	0.78	G	0.2	0.34	0.51	M3	0.17	0.16	21.3	M3,G	7	8.9	15.9		2.5	0	1.21		0.24	0.02	0.88	LT,G	0.45	0.64	17.2		2.7	0
	6-SB-34-BS-P-03	7/4/07	3	4	0.77	G	0.23	0.42	0.3	M3	0.12	0.14	0.7	U,M,G	4.8	8.4	0.65	Y2	0.18	0.04	0.07	Y2,LT	0.05	0.03	0.26	U,G	0.41	0.68	0.62	Y2	0.18	0.06
6-SB-35	6-SB-35-SS-P-00	7/4/07	0	1	0.83	G	0.22	0.35	1.17	M3	0.29	0.22	25.9	G	4.2	3.1	26.5		4.2	0.1	1.94		0.39	0.04	1.29	LT,G	0.41	0.7	27.8		4.4	0.1
	6-SB-35-BS-P-03	7/4/07	3	4	1.33	G	0.27	0.36	0.6	M3	0.15	0.11	0.6	U,G	1.1	1.9	0.76		0.16	0.01	0.06	LT	0.03	0.02	-0.09	U,G	0.34	0.63	0.81		0.16	0.02
6-SB-36	6-SB-36-SS-P-00	7/4/07	0	1	0.6	G	0.19	0.34	0.51	M3	0.16	0.14	7.8	G	2	2.2	8.8		1.4	0	0.62		0.15	0.03	0.48	LT,G	0.31	0.46	8.6		1.4	0
	6-SB-36-BS-P-02	7/4/07	2	3	0.64	G	0.2	0.32	0.35	M3	0.11	0.12	71.7	G	9.4	3.5	70	Y2,M3	12	0	5.70	Y2,M3	1.1	0.1	4.07	G	0.72	0.8	74	Y2	13	0
6-SB-37	6-SB-37-SS-P-00	7/4/07	0	1	0.54	G	0.19	0.37	0.3	M3	0.1	0.12	66	M3,G	11	8	53.2	Y2	9.3	0.1	3.35	Y2	0.69	0.06	3.38	G	0.68	0.83	56.8	Y2	9.9	0.1
	6-SB-37-BS-P-01	7/4/07	1	2	0.88		0.21	0.37	0.49	M3	0.13	0.12	49.3		6.7	2.9	57.6	Y2,M3	10	0.1	4.03	Y2	0.83	0.06	2.35		0.5	0.64	61	Y2	11	0
6-SB-38	6-SB-38-SS-P-00	7/4/07	0	1	9.8	M3,G	1.2	0.8	69	M3	11	0	1720	M3,G	210	40	1770	Y2,M3	340	0	105	Y2,M3	23	1	97	M3,G	12	3	1830	Y2,M3	350	0
	6-SB-38-BS-P-01	7/4/07	1	2	0.75	G,T1	0.28	0.44	0.7	M3	0.17	0.12	360	M3,G	43	8	360	Y2,M3	63	1	20	Y2,M3	5	0.9	19.4	G	2.5	1.3	366	Y2,M3	64	1
6-SB-39	6-SB-39-SS-P-00	7/4/07	0	1	0.63	G	0.18	0.34	0.48	M3	0.13	0.12	4.3	U,M,G	4.5	7.2	5.25		0.88	0.03	0.30		0.09	0.03	0.38	U,G	0.35	0.56	5.47		0.91	0.02
	6-SB-39-BS-P-01	7/4/07	1	2	0.74		0.19	0.37	0.39	M3	0.13	0.14	1.7	U	1.4	2.1	2.39		0.43	0.03	0.14		0.06	0.03	0.35	U	0.34	0.54	2.37		0.43	0.01
6-SB-40	6-SB-40-SS-P-00	7/4/07	0	1	0.8	G	0.22	0.41	0.67	M3	0.17	0.12	2.9	LT,G	1.9	2.8	2.53		0.46	0.03	0.19		0.07	0.02	0.31	U,G	0.4	0.65	2.52		0.46	0.03
	6-SB-40-BS-P-05	7/4/07	5	6	0.37	LT,G	0.17	0.34	0.34	M3	0.12	0.13	4	U,M,G	4	6.4	0.55		0.15	0.06	0.09	LT	0.05	0.04	0.07	U,G	0.33	0.59	0.72		0.18	0.07
6-SB-41	6-SB-41-SS-P-00	7/4/07	0	1	0.61	G	0.19	0.33	0.49		0.12	0.09	1.3	U,M,G	4.3	7.4	1.81		0.36	0.03	0.21		0.08	0.02	0.31	U,G	0.4	0.65	1.78		0.36	0.04
	6-SB-41-BS-P-05	7/4/07	5	6	0.82	G	0.2	0.29	0.54		0.12	0.09	6.7	G	2	2.5	1.88		0.37	0.05	0.15		0.07	0.04	0.55	LT,G	0.37	0.55	1.93		0.37	0.01

Notes:

ft bgs = Feet below ground surface
MDC = Minimum Detectable Concentration
pCi/g = picoCuries per gram
TPU = Total Propagated Uncertainty
G = Sample density differs by more than 15% of LCS density: sample results may be biased
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC
TI = Nuclide identification is tentative
U = Result is less than the sample specific MDC
Y2 = Chemical yield outside default limits

Table 6-23
Metals Exceeding Preliminary Remediation Goals in Soil Samples, AOC 6

		Analyte	ANTIMONY	ARSENIC	CADMIUM	CHROMIUM	IRON	MERCURY
		NJDEP SCC (mg/kg)	14	20	39	NA	NA	14
		Region 6 PRG (mg/kg)	**31.3**	**0.39**	**39**	**30.1**	**54750**	**6.11**
Sample ID	**Sample Date**	**End Depth (ft bgs)**	**Result (mg/kg) Flag**	**Result (mg/kg) Flag**	**Result (mg/kg) Flag**	**Result (mg/kg) Flag**	**Result (mg/kg) Flag**	**Result (mg/kg) Flag**
6-SB-32-BS-P-04	7/4/07	**4 / 5**		2.5				
6-SB-33-BS-P-03	7/4/07	**3 / 4**		1.9				
6-SB-33-SS-P-00	7/4/07	**0 / 1**		1.6				
6-SB-34-BS-P-03	7/4/07	**3 / 4**		1.2				
6-SB-34-SS-P-00	7/4/07	**0 / 1**		1.6				
6-SB-35-BS-P-03	7/4/07	**3 / 4**		1.8				
6-SB-35-SS-P-00	7/4/07	**0 / 1**		1.9				
6-SB-36-BS-P-02	7/4/07	**2 / 3**		1.8				
6-SB-36-SS-P-00	7/4/07	**0 / 1**		1.6				
6-SB-37-BS-P-01	7/4/07	**1 / 2**		1.3				
6-SB-37-SS-P-00	7/4/07	**0 / 1**		1.7				
6-SB-38-BS-P-01	7/4/07	**1 / 2**		2.4				
6-SB-38-SS-P-00	7/4/07	**0 / 1**		2.5				
6-SB-39-BS-P-01	7/4/07	**1 / 2**		1.4				
6-SB-39-SS-P-00	7/4/07	**0 / 1**		1.5				
6-SB-40-BS-P-05	7/4/07	**5 / 6**	280	11	52	140	120000	
6-SB-40-SS-P-00	7/4/07	**0 / 1**		1.8				
6-SB-41-BS-P-05	7/4/07	**5 / 6**	36	3.7				
6-SB-41-SS-P-00	7/4/07	**0 / 1**		2.3				11 *

Notes:

ft bgs = Feet below ground surface
mg/kg = milligrams per kilogram
N/A = Not Applicable
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria

Table 6-24
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Soil Samples, AOC 6

			Sample ID	6-SB-33-BS-P-03		6-SB-38-BS-P-01		6-SB-38-SS-P-00		6-SB-40-BS-P-05		6-SB-41-BS-P-05		6-SB-41-SS-P-00	
			Sample Date	7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007	
			StartDepth / EndDepth (ft bgs)	3 / 4		1 / 2		0 / 1		5 / 6		5 / 6		0 / 1	
	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)		Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
SVOC															
AZOBENZENE	NA	**4420**								5000					
CARBAZOLE	NA	**24300**		34000						47000					
VOC															
NAPHTHALENE	230000	**125000**								270000		560000			

Notes:

ft bgs = Feet below ground surface
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
µg/kg = micrograms per kilogram
J = Estimated result

Table 6-25
PAHs and PCBs Exceeding Preliminary Remediation Goals in Soil Samples, AOC 6

Sample ID			6-SB-33-BS-P-03		6-SB-34-BS-P-03		6-SB-34-SS-P-00		6-SB-35-BS-P-03		6-SB-38-BS-P-01		6-SB-40-BS-P-05		6-SB-40-SS-P-00		6-SB-41-BS-P-05		6-SB-41-SS-P-00	
Sample Date			7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007		7/4/2007	
StartDepth / EndDepth (ft bgs)			3 / 4		3 / 4		0 / 1		3 / 4		1 / 2		5 / 6		0 / 1		5 / 6		0 / 1	
	NJDEP SCC (ug/kg)	Reg 6 PRG (ug/kg)	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag	Result (ug/kg)	Flag
PAH																				
BENZO(A)ANTHRACENE	900	**148**	3200	B					150	B			15000	B	4100	B	210000	B	140000	B
BENZO(A)PYRENE	660	**14.8**	370		18		29		22		97		3300		710		35000		29000	
BENZO(B)FLUORANTHENE	900	**148**	720								240		5800		1100		59000		53000	
BENZO(K)FLUORANTHENE	900	**1480**											2800				28000		26000	
CHRYSENE	9000	**14800**	15000										45000				740000		430000	
DIBENZO(A,H)ANTHRACENE	660	**14.8**	52								19		270		97		4700		3800	
FLUORENE	2300000	**2644000**															10000000		3700000	
INDENO(1,2,3-CD)PYRENE	900	**148**											730		260		12000		9200	
NAPHTHALENE	230000	**125000**															620000			

Notes:

ft bgs = Feet below ground surface
PRG = Preliminary Remediation Goal
SCC = Soil Cleanup Criteria
µg/kg = micrograms per kilogram
B = Analyte is detected in blank as well as sample

Table 6-26
Water Level Data, AOC 6

Quarter	Date	Well ID	Elev Top of Riser (NAVD 88)	Total Well Depth (ft)	Screen Length (ft)	Depth to water (ft)	Elev GW (NAVD 88)
B Aquifer Wells							
Q3	1/25/06	6-MW-01B	5.17	17.35	10	8.95	-3.78
Q4	5/5/06		5.17	17.35	10	9.49	-4.32
Q5	9/15/2006		5.17	17.35	10	10.03	-4.86
Q6	2/14/07		5.17	17.35	10	8.91	-3.74
Q7	5/8/07		5.17	17.35	10	7.19	-2.02
					AVERAGE	**8.914**	**-3.744**
Q3	1/25/06	6-MW-02B	5.33	17.44	10	8.8	-3.47
Q4	5/5/06		5.33	17.44	10	9.41	-4.08
Q5	9/19/2006		5.33	17.44	10	9.91	-4.58
Q6	2/13/07		5.33	17.44	10	8.85	-3.52
Q7	5/8/07		5.33	17.44	10	7.13	-1.80
					AVERAGE	**8.82**	**-3.49**
Q3	1/26/06	6-MW-03B	5.82	17.56	10	9.5	-3.68
Q4	5/5/06		5.82	17.56	10	10.06	-4.24
Q5	9/15/2006		5.82	17.56	10	10.65	-4.83
Q6	2/13/07		5.82	17.56	10	9.51	-3.69
Q7	5/8/07		5.82	17.56	10	7.82	-2.00
					AVERAGE	**9.508**	**-3.688**
Q4	6/14/06	6-MW-04B	5.86	19.63	10	10.18	-4.32
Q5	9/15/2006		5.86	19.63	10	10.86	-5.00
Q6	2/14/07		5.86	19.63	10	9.68	-3.82
Q7	5/8/07		5.86	19.63	10	8.06	-2.20
					AVERAGE	**9.695**	**-3.835**
Q4	6/15/06	6-MW-05B	6.89	18.79	10	11.09	-4.20
Q5	9/19/2006		6.89	18.79	10	11.84	-4.95
Q6	2/13/07		6.89	18.79	10	10.74	-3.85
Q7	5/8/07		6.89	18.79	10	8.99	-2.10
					AVERAGE	**10.665**	**-3.775**
Q4	6/15/06	6-MW-06B	5.44	19.07	10	4.56	0.88
Q5	9/18/2006		5.44	19.07	10	10.02	-4.58
Q6	2/13/07		5.44	19.07	10	8.94	-3.50
Q7	5/8/07		5.44	19.07	10	7.2	-1.76
					AVERAGE	**7.68**	**-2.24**
Q4	6/14/06	6-MW-07B	5.18	49.05	10	12.37	-7.19
Q5	9/15/2006		5.18	49.05	10	13.88	-8.70
Q6	2/14/07		5.18	49.05	10	11.98	-6.80
Q7	5/8/07		5.18	49.05	10	10.09	-4.91
					AVERAGE	**12.08**	**-6.9**
					B AQUIFER AVERAGE	**9.57**	**-3.92**

Notes

Elev = Elevation

ft = Feet

GW = Groundwater

Table 6-27
YSI Water Quality Data, AOC 6

Quarter	Date	Well ID	Temp. ºC	pH	Cond. (mS/cm^3)	Turb (NTU)	DO (mg/L)	ORP (mV)
B Aquifer Wells								
Q3	1/25/06	6-MW-01B	12.6	6.27	1	3	UL	29
Q4	5/5/06		16.5	6.05	1510	0	0	80
Q5	9/15/06		22.4	6.33	912	3	2	72
Q6	2/14/07		7.62	6.56	906	32	0	213
Q7	5/8/07		16.32	6.25	638	16	0	70
		AVERAGE	**15.08**	**6.29**	**793.37**	**10.88**	**0.48**	**92.91**
Q3	1/25/06	6-MW-02B	12.5	5.94	0	77	0	108
Q4	5/5/06		14.9	5.34	803	0	1	448
Q5	9/19/06		20.93	5.87	452	8	3	170
Q6	2/13/07		6.16	5.97	346	8	LL	217
Q7	5/8/07		15.08	5.87	516	LL	6	203
		AVERAGE	**13.93**	**5.80**	**423.39**	**23**	**3**	**229**
Q3	1/26/06	6-MW-03B	13.1	5.59	2	1	UL	105
Q4	5/5/06		14.9	5.15	1573	0	1	183
Q5	9/15/06		23.43	4.93	1457	7	2	191
Q6	2/13/07		9.88	5.79	572	48	2	202
Q7	5/8/07		14.58	5.94	2112	1	LL	119
		AVERAGE	**15.18**	**5.48**	**1143.18**	**11.35**	**1**	**160**
Q4	6/14/06	6-MW-04B	18.58	6.41	1694	9	1	-19
Q5	9/15/06		22.89	6.39	2249	10	2	-47
Q6	2/14/07		7.56	6.37	2162	14	0	199
Q7	5/8/07		15.24	6.21	2211	LL	0	-35
		AVERAGE	**16.07**	**6.35**	**2078.93**	**11.02**	**0.79**	**24.56**
Q5	9/19/06	6-MW-05B	22.87	6.7	1193	1	2	-28
Q6	2/13/07		10.14	6.94	1068	66	2	37
Q7	5/8/07		17.57	7.27	1373	31	0	-97
		AVERAGE	**16.86**	**6.97**	**1211.29**	**32.36**	**1.26**	**-29.43**
Q5	9/18/06	6-MW-06B	24.01	6.24	1367	7	1	10
Q6	2/13/07		11.29	6.76	1535	9	LL	181
Q7	5/8/07		15.97	6.80	1324	LL	1	-69
		AVERAGE	**17.09**	**6.60**	**1408.46**	**7.86**	**0.91**	**40.67**
Q5	9/15/06	6-MW-07B	19.27	11.83	1918	2	1	-52
Q6	2/14/07		13.30	6.94	1521	41	2	-101
Q7	5/8/07		18.26	6.86	1879	LL	0	-92
		AVERAGE	**16.9**	**8.5**	**1772.4**	**21.6**	**0.8**	**-81.7**
		B AQUIFER AVERAGE	**15.6**	**6.4**	**1189.0**	**16.4**	**1.2**	**82.1**

Notes:

ºC = Degrees Celsius
DO = Dissolved Oxygen
LL = Lower Limit, which is 0 for turbidity and D.O.
mg/L = milligrams per liter
mS/cm^3 = Micro Siemens per cubic centimeters
Mv = millivolts
NM = Not Measured (dry well)
NTU = Nephelometric Turbidity Unit
UL = Upper Limit, which is 9.1 for D.O.
ORP = Oxidation Reduction Potential
LLs and ULs are not calculated into the average

Table 6-28
HACH Kit Water Quality Data, AOC 6

Quarter	Date	Well ID	Fe^{2+} (mg/L)	S^{2-} (mg/L)	NO_2^- (mg/L)	H_2O_2 (mg/L)	Comment
B Aquifer Wells							
Q3	1/25/06	6-MW-01B	2.35	0.01	0.00	0.20	
Q4	5/5/06	6-MW-01B	0.00	0.01	NM	2.00	
Q5	9/15/06	6-MW-01B	0.03	0.02	0.008	0.5	
Q6	2/14/07	6-MW-01B	0.06	0.05	0.006	0.5	
Q7	5/8/07	6-MW-01B	0.18	0.09	0.00	2.00	PID = 0
		AVERAGE	**0.52**	**0.04**	**0.00**	**1.04**	
Q3	1/25/06	6-MW-02B	1.02	0.01	0.021	1.00	
Q4	5/5/06	6-MW-02B	0.07	0.00	0.00	1.20	NO2 possibly between 0 and 0.002
Q5	9/19/06	6-MW-02B	0.02	0.01	0.008	0.50	
Q6	2/13/07	6-MW-02B	0.08	0.01	0.025	0.00	
Q7	5/8/07	6-MW-02B	0.09	0.00	0.016	0.00	PID = 0
		AVERAGE	**0.26**	**0.01**	**0.01**	**0.54**	
Q3	1/26/06	6-MW-03B	1.84	0.05	0.00	0.20	NO2 possibly between 0 and 0.002
Q4	5/5/06	6-MW-03B	3.30	0.00	0.00	0.40	Fe2+ possibly > than 3.3
Q5	9/15/06	6-MW-03B	2.03	0.03	0.00	0.00	
Q6	2/13/07	6-MW-03B	0.25	0.02	0.004	0.00	
Q7	5/8/07	6-MW-03B	1.92	0.01	0.00	0.00	PID = 0
		AVERAGE	**1.87**	**0.02**	**0.00**	**0.12**	
Q4	6/14/06	6-MW-04B	3.30	0.03	0.00	0.00	Fe2+ possibly > than 3.3. NO2 possibly between 0 and 0.002
Q5	9/15/06	6-MW-04B	3.30	0.02	0.00	0.00	Fe2+ possibly > than 3.3
Q6	2/14/07	6-MW-04B	2.21	0.03	0.00	0.00	
Q7	5/8/07	6-MW-04B	2.85	0.00	0.00	0.00	PID = 0
		AVERAGE	**2.92**	**0.02**	**0.00**	**0.00**	
Q4	6/15/06	6-MW-05B	0.06	0.01	0.001	0.0	
Q5	9/19/06	6-MW-05B	1.48	0.01	0.00	0.00	
Q6	2/13/07	6-MW-05B	2.24	0.01	0.00	0.00	
Q7	5/8/07	6-MW-05B	2.22	0.01	0.00	0.50	PID = 0
		AVERAGE	**1.50**	**0.01**	**0.00**	**0.13**	
Q4	6/15/06	6-MW-06B	1.06	0.01	0.00	0.00	NO2 possibly between 0 and 0.002
Q5	9/18/06	6-MW-06B	2.26	0.11	0.002	0.00	
Q6	2/13/07	6-MW-06B	2.10	0.00	0.003	0.00	
Q7	5/8/07	6-MW-06B	0.15	0.01	0.00	2.00	PID = 0
		AVERAGE	**1.39**	**0.03**	**0.00**	**0.50**	
Q4	6/14/06	6-MW-07B	3.30	0.02	0.00	0.00	NO2 possibly between 0 and 0.002
Q5	9/15/06	6-MW-07B	0.04	0.04	0.00	0.50	NO2 possibly between 0 and 0.002
Q6	2/14/07	6-MW-07B	0.03	0.02	0.00	0.50	
Q7	5/8/07	6-MW-07B	0.86	0.07	0.00	0.50	PID = 0
		AVERAGE	**1.06**	**0.04**	**0.00**	**0.38**	
		B AQUIFER AVERAGE	**1.31**	**0.02**	**0.00**	**0.40**	

Notes:

mg/L = milligrams per liter

NM = Not measured (dry well)

Table 6-29
Major Ions in Groundwater, AOC 6

	Analyte		CHLORIDE		FLUORIDE		NITRATE/NITRITE AS N		SULFATE (SO4)		TOTAL ALKALINITY As CaCO3		TOTAL PHOSPHORUS	
NJDEP WQC (mg/L)			250		NA		NA		250		NA		NA	
Region 6 Tap Water PRG (mg/L)			**NA**		**2.19**		**NA**		**NA**		**NA**		**0.00073**	
Sample ID	**Sample Date**	**Qtr #**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**	**Result**	**Flag**
B Aquifer														
6-MW-01-GU-P-02	**5/5/06**	**4**	320	J	0.5		0.37		47		160		0.05	U
	9/15/06	**5**	130		1		0.01	U	80		220		0.23	
	2/14/07	**6**	83		0.79		0.01	U	130		220		0.12	
	5/8/07	**7**	83		0.17		0.2	U	66		120		0.17	
AVERAGE			***154***		***0.62***		***0.15***		***81***		***180***		***0.14***	
6-MW-02-GU-P-02	**5/5/06**	**4**	160	J	0.3		0.86		65		43		0.05	U
	9/19/06	**5**	88		0.34		0.95		42		50		0.05	U
	2/13/07	**6**	40		0.26		0.96		49		46		0.053	
	5/8/07	**7**	100		0.28		1.3		53		32		0.05	U
AVERAGE			***97***		***0.30***		***1.02***		***52***		***43***		***0.05***	
6-MW-03-GU-P-02	**1/26/06**	**3**	520	J	0.36		0.22		69		44		0.05	U
	5/5/06	**4**	380	J	0.26		0.86		83		17		0.05	U
	9/15/06	**5**	440		0.31		0.029		79		11		0.05	U
	2/13/07	**6**	180		0.23		0.01	U	61		39		0.05	U
	5/8/07	**7**	620		0.2		0.015		56		71		0.05	U
AVERAGE			***428***		***0.27***		***0.23***		***70***		***36***		***0.05***	
6-MW-04-GU-P-02	**6/15/06**	**4**	420		1.9		0.31		120	J	190		0.13	
	9/15/06	**5**	650		1.2		0.01	U	65		150		0.21	
	2/14/07	**6**	570		1.2		0.05	U	45		150		0.17	
	5/8/07	**7**	590		1.2		2	U	42		150		0.096	
AVERAGE			***558***		***1.4***		***0.59***		***68***		***160***		***0.15***	
6-MW-05-GU-P-02	**6/15/06**	**4**	110		1		0.17		410	J	130		0.05	U
	9/19/06	**5**	57		1.1		0.11		410		200		0.15	
	2/13/07	**6**	130		0.68		0.01	U	510		91		0.05	U
	5/8/07	**7**	47		0.78		0.018		510		200		0.12	
AVERAGE			***86***		***0.89***		***0.077***		***460***		***155***		***0.093***	
6-MW-06-GU-P-02	**6/15/06**	**4**	6.7		0.96		2.1		510	J	320		0.089	
	9/18/06	**5**	7.8		0.99		0.23		550		340		0.19	
	2/13/07	**6**	7.8		1.1		0.057		580		340		0.18	
	5/8/07	**7**	6.1		1.2		0.01	U	470		280		0.17	
AVERAGE			***7.1***		***1.06***		***0.60***		***528***		***320***		***0.16***	
6-MW-07-GU-P-02	**6/15/06**	**4**	40		1.4		0.015		940	J	57		0.067	
	9/15/06	**5**	42		1.1		0.022		890		90		0.14	
	2/14/07	**6**	51		0.96		0.05	U	940		79		0.17	
	5/8/07	**7**	46		1.1				920		110		0.11	
AVERAGE			***45***		***1.14***		***0.029***		***923***		***84***		***0.122***	
B AQUIFER AVERAGE			***204.32***		***0.79***		***0.39***		***303.17***		***136.21***		***0.11***	

Notes:

$CaCO_3$ = Calcium carbonate
mg/L = milligrams per liter
N = Nitrogen
NA = Not Applicable
PRG = Preliminary Remediation Goal
Qtr = Quarter
WQC = Water Quality Criteria
J = Estimated result
U = Not Detected
All samples are unfiltered

Table 6-30
Isotopic and Total Uranium in Groundwater, AOC 6

	Analyte	U-234		U-235		U-238		Uranium (Total)		
	MCL	N/A		N/A		N/A		30 (ug/L)		
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Result (ug/L) Flag	TPU [+/- 2σ]
B Aquifer										
6-MW-01-GU-P-02	1/25/06	252	41	14	3.5	249	41	509	763	84
	5/5/06	58.5 J	10	3.06 J	0.72	61 J	11	125	187 J	22
	9/15/06	34.8	6	1.48	0.41	36.6	6.3	75	112	13
	2/14/07	50.7	8.5	3.28	0.7	53.6	9	110	165	18
	5/8/07	35.1	6.1	1.84	0.47	34.7	6	71	106	12
	AVERAGE	***86.2***		***4.73***		***87.0***			***267***	
6-MW-02-GU-P-02	1/25/06	0.318 U	0.086	0.064 U	0.039	0.248 U	0.075	0.51	0.76 U	0.15
	5/5/06	0.24 J	0.12	0.085 J	0.075	0.12 J	0.084	0.24	0.36 J	0.17
	9/19/06	0.075 U	0.071	-0.003 U	0.055	0.111 U	0.09	0.23	0.34 U	0.18
	2/13/07	0.052 U	0.063	0.016 U	0.052	0.141 LT	0.093	0.29	0.43 LT	0.19
	5/8/07	0.057 U	0.073	-0.015 U	0.066	0.056 U	0.082	0.11	0.16 U	0.17
	AVERAGE	***0.148***		***0.029***		***0.135***			***0.41***	
6-MW-03-GU-P-02	1/26/06	0.94	0.28	0.17	0.12	0.77	0.24	1.57	2.35	0.49
	5/5/06	0.99 J	0.29	0.065 J	0.066	0.88 J	0.26	1.8	2.7 J	0.54
	9/15/06	0.73	0.22	0.04 LT	0.049	0.74	0.22	1.52	2.28	0.45
	2/13/07	0.17 LT	0.11	0.007 U	0.061	0.2 LT	0.12	0.41	0.61 LT	0.24
	5/8/07	0.53	0.21	0.055 U	0.073	0.36	0.17	0.74	1.11	0.35
	AVERAGE	***0.67***		***0.067***		***0.59***			***1.81***	
6-MW-04-GU-P-02	6/15/06	1.12 J	0.33	0.44 J	0.2	0.98 J	0.3	2.01	3.01 J	0.62
	9/15/06	0.61	0.2	0.024 U	0.05	0.4	0.16	0.82	1.23	0.32
	2/14/07	0.46	0.18	0.084 U	0.079	0.35	0.15	0.71	1.06	0.31
	5/8/07	0.54	0.21	0.044 U	0.064	0.33	0.16	0.68	1.02	0.34
	AVERAGE	***0.68***		***0.148***		***0.52***			***1.58***	
6-MW-05-GU-P-02	6/15/06	0.32 J	0.14	0.024 U	0.052	0.166 J	0.095	0.34	0.51 J	0.19
	9/19/06	0.25	0.11	0.031 U	0.047	0.115 LT	0.08	0.24	0.36 LT	0.16
	2/13/07	0.26	0.12	0.029 U	0.052	0.19 LT	0.1	0.38	0.57 LT	0.21
	5/8/07	0.52	0.21	-0.005 U	0.068	0.3	0.15	0.62	0.93	0.31
	AVERAGE	***0.34***		***0.020***		***0.193***			***0.59***	
6-MW-06-GU-P-02	6/15/06	1.53 J	0.39	0.23 J	0.13	1.54 J	0.39	3.14	4.71 J	0.79
	9/18/06	1.94	0.44	0.069 LT	0.063	2.07	0.46	4.24	6.36	0.94
	2/13/07	2.07	0.47	0.072 U	0.07	1.76	0.42	3.61	5.41	0.86
	5/8/07	1.8	0.44	0.062 U	0.068	1.52	0.39	3.11	4.66	0.8
	AVERAGE	***1.84***		***0.108***		***1.72***			***5.28***	
6-MW-07-GU-P-02	6/15/06	0.56 J	0.19	0.16 J	0.1	0.19 J	0.11	0.38	0.57 J	0.22
	9/15/06	0.38	0.16	0.006 U	0.052	0.138 LT	0.093	0.28	0.42 LT	0.19
	2/14/07	0.25	0.12	0.021 U	0.055	0.164 LT	0.097	0.34	0.51 LT	0.2
	5/8/07	1.34	0.35	0.059 U	0.064	1.17	0.32	2.39	3.58	0.65
	AVERAGE	***0.63***		***0.062***		***0.416***			***1.27***	
B AQUIFER AVERAGE		***14.49***		***0.82***		***14.51***			***44.53***	

Notes:

MCL = Maximum Contaminant Level
NA = Not Applicable
pCi/L = picoCuries per liter
TPU = Total Propagated Uncertainty
µg/L = micrograms per Liter
J = Estimated result
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
All samples are unfiltered
pCi/L results are converted to µg/L by dividing the result by 0.667
Shading indicate results above 30 ug/L

pCi/L results are converted to µg/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Table 6-31
Radiochemical Analysis of Groundwater, AOC 6

Analyte		GROSS ALPHA		GROSS BETA		Ra-226		Ra-228		Th-228		Th-230		Th-232	
MCL		15		N/A		5 (combined Ra226/228)		5 (combined Ra226/228)		N/A		N/A		N/A	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
B Aquifer Wells															
6-MW-01-GU-P-02	1/25/06	317	51	144	23	0.57 J	0.25	1.57 J	0.66						
	5/5/06	76	12	44.2	7.4	0.4 J	0.2	0.99 J	0.49	0.016 U	0.061	0.027 U	0.064	0.009 U	0.021
	9/15/06	71	12	27	4.8	0.26 Y1,LT	0.16	0.77 LT	0.45	0.049 U	0.064	0.072 U	0.067	0.003 U	0.016
	2/14/07	99	16	59.1	9.8	0.43 LT	0.23	1.36	0.66	0.079 U	0.061	0.08 U	0.071	0.047 LT	0.031
	5/8/07	31.2	5.7	18.2	3.7	0.2 U	0.17	0.47 U,M	0.63	0.036 U	0.071	-0.022 U	0.054	0.018 LT	0.023
	AVERAGE	***119***		***58.5***		***0.37***		***1.03***		***0.045***		***0.039***		***0.019***	
6-MW-02-GU-P-02	1/25/06	2.06	0.52	4.3	1	0.61 J	0.26	1.49 J	0.65						
	5/5/06	1.55	0.6	6	1.4	0.67 J	0.28	1.45 J	0.59	0.062 U	0.07	0.007 U	0.059	0.021 U	0.021
	9/19/06	2.4 LT	1.3	4.5	1.9	0.36 LT	0.18	0.66 U	0.4	0.011 U	0.067	-0.061 U	0.049	0.02 U	0.022
	2/13/07	1.01 U	0.94	3.6 LT	1.8	0.11 U	0.11	0.39 U	0.35	0.001 U	0.068	0.063 U	0.073	-0.001 U	0.02
	5/8/07	1.19 U	0.89	6.9	2.1	0.42 LT	0.22	0.69 U	0.52	0.013 U	0.059	-0.021 U	0.053	-0.012 U	0.02
	AVERAGE	***1.64***		***5.1***		***0.43***		***0.94***		***0.022***		***-0.003***		***0.007***	
6-MW-03-GU-P-02	1/26/06	3.6	1.2	10	2.3	0.69 J	0.28	1.4 J	0.56						
	5/5/06	2.47	0.97	6.4	1.9	0.49 J	0.23	0.78 U	0.48	0.09 U	0.068	-0.087 U	0.05	0.004 U	0.022
	9/15/06	3.9	1.3	9	2.3	0.81 LT	0.32	1.38	0.58	0.016 U	0.072	0.064 U	0.069	0.006 U	0.018
	2/13/07	0.48 U	0.75	4 LT	1.7	0.2 LT	0.15	0.48 U	0.36	-0.007 U	0.074	-0.02 U	0.068	0.027 U	0.034
	5/8/07	5.5	1.9	9.6 M3	3	0.49 LT	0.25	2.07 M3	0.86	0.035 U	0.06	-0.009 U	0.054	0.003 U	0.026
	AVERAGE	***3.2***		***7.8***		***0.54***		***1.22***		***0.0335***		***-0.013***		***0.010***	
6-MW-04-GU-P-02	6/15/06	2.5	1	8.6	2.5	0.43 J	0.21	0.72 U	0.45	0.019 U	0.091	0.015 U	0.065	0.004 U	0.025
	9/15/06	2.7 LT	1.5	7.1	2.6	0.5 LT	0.23	0.82 LT	0.48	0.036 U	0.073	-0.013 U	0.056	0.006 U	0.017
	2/14/07	2.3 LT	1.2	7.4	2.4	0.31 LT	0.19	1.04	0.51	0.081 U	0.058	0.019 U	0.051	0.026 LT	0.02
	5/8/07	2 U	1.7	9.1 M3	3	0.46 Y1,LT	0.23	1.07 U,M	0.64	0.031 U	0.057	0.009 U	0.058	0.004 U	0.022
	AVERAGE	***2.4***		***8.1***		***0.43***		***0.91***		***0.042***		***0.008***		***0.010***	
6-MW-05-GU-P-02	6/15/06	0.24 U	0.77	4.4	1.8	0.13 U	0.11	0.51 U	0.38	0.052 U	0.094	0.171 J	0.085	-0.007 U	0.029
	9/19/06	2.1 LT	1.3	7.1	2.3	0.12 U	0.11	0.37 U	0.37	0.013 U	0.067	0.133 LT	0.078	0.025 U	0.029
	2/13/07	1.8 LT	1	6.5	2.3	0.015 U	0.072	0.15 U	0.37	0.012 U	0.057	-0.005 U	0.059	0.011 U	0.019
	5/8/07	1.4 U	1.2	3.2 U	2.4	0.003 U	0.071	0.55 U,M	0.67	-0.021 U	0.049	0.007 U	0.057	0.012 U	0.02
	AVERAGE	***1.4***		***5.3***		***0.067***		***0.40***		***0.01***		***0.077***		***0.01025***	
6-MW-06-GU-P-02	6/15/06	2.5	1.2	4.5	1.9	0.16 J	0.12	0.43 U	0.41	-0.01 U	0.11	0.092 U	0.078	0.017 U	0.024
	9/18/06	2.6 LT	1.2	8	2.4	0.14 Y1,U	0.11	0.74 U	0.44	-0.043 U	0.051	-0.006 U	0.063	0.019 U	0.026
	2/13/07	5.8	1.8	6.6	2.5	0.13 U	0.12	-0.01 U	0.32	0.017 U	0.07	-0.002 U	0.059	0.02 LT	0.02
	5/8/07	1.8 U	1.6	3.5 U	2.3	0.052 U	0.091	0.82 U,M	0.62	-0.027 U	0.068	0.019 U	0.059	0.001 U	0.02
	AVERAGE	***3.2***		***5.7***		***0.12***		***0.50***		***-0.016***		***0.026***		***0.014***	

Table 6-31
Radiochemical Analysis of Groundwater, AOC 6
(cont.)

Analyte		GROSS ALPHA		GROSS BETA		Ra-226		Ra-228		Th-228		Th-230		Th-232	
MCL (pCi/L)		15		N/A		5 (combined Ra226/228)		5 (combined Ra226/228)		N/A		N/A		N/A	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
6-MW-07-GU-P-02	6/15/06	1 U	1.4	2.9 U	3	0.052 U	0.08	0.45 U	0.38	0.008 U	0.095	-0.008 U	0.061	0.015 J	0.019
	9/15/06	0.4 U,M	1.9	9.1 M3	3.2	0.071 Y1,U	0.088	0.35 U	0.42	0.079 U	0.076	-0.003 U	0.058	0.013 U	0.02
	2/14/07	1.8 U	1.8	17.6 M3	4.4	0.26 LT	0.17	0.97 LT	0.52	-0.01 U	0.044	0.003 U	0.057	U	0.017
	5/8/07	5	1.7	27.5 M3	5.3	0.22 Y1,LT	0.15	0.55 U,M	0.54	0.03 U	0.069	-0.018 U	0.053	0.018 U	0.024
AVERAGE		***2.1***		***14.3***		***0.15***		***0.58***		***0.027***		***-0.0065***		***0.015***	
B AQUIFER AVERAGE		**20.45**		***15.31***		***0.31***		***0.80***		***0.02***		***0.02***		***0.01***	

Notes:

MCL = Maximum Contaminant Level
NA = Not Applicable
pCi/L = picoCuries per liter
TPU = Total Propagated Uncertainty
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
M3 = The requested MDC was not met, but the reported activity is greater than the reported MDC
U = Result is less than the sample specific MDC
Y1 = Chemical yield is in control at 100-110%. Quantitative yield is assumed.
Shadeing indicate detected concentrations which equal or exceed the MCLs

Table 6-32
Metals Exceeding Preliminary Remediation Goals in Groundwater, AOC 6

Analyte		ARSENIC		IRON		LEAD		MANGANESE	
NJDEP WQC (mg/L)		0.003		0.3		0.005		0.05	
Region 6 Tap Water PRG (mg/L)		4.4821E-05		25.55		0.015		1.70309	
Sample ID	Sample Date	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag
B Aquifer Wells									
6-MW-01-GU-P-02	5/5/06	0.014							
	9/15/06	0.014							
	2/14/07	0.012							
	5/8/07					0.077			
AVERAGE		***0.013***		***N/A***		***0.077***		***N/A***	
6-MW-03-GU-P-02	1/26/06							2.3 J	
	5/5/06							2.1	
	9/15/06							2.1	
AVERAGE		***N/A***		***N/A***		***N/A***		***2.167***	
6-MW-04-GU-P-02	6/15/06	0.011		26 J					
	9/15/06	0.021		35					
	2/14/07	0.02		36					
	5/8/07	0.019		34					
AVERAGE		***0.018***		***32.750***		***N/A***		***N/A***	
6-MW-07-GU-P-02	2/14/07	0.012							
	5/8/07	0.01							
AVERAGE		***0.011***		***N/A***		***N/A***		***N/A***	
B AQUIFER AVERAGE		***0.015***		***32.750***		***0.077***		***2.167***	

Notes:

mg/L = milligrams per liter
NA = Not Applicable
PRG = Preliminary Remediation Goal
WQC = Water Quality Criteria
J = Estimated result
All samples are unfiltered

Table 6-33
VOCs and SVOCs Exceeding Preliminary Remediation Goals in Groundwater, AOC 6

		1,2,4-TRICHLOROBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	4-CHLOROANILINE	ANILINE	CARBAZOLE	NAPHTHALENE	NITROBENZENE	1,2,4-TRICHLOROBENZENE	1,2-DICHLOROBENZENE	1,3-DICHLOROBENZENE	1,4-DICHLOROBENZENE	CHLOROBENZENE	NAPHTHALENE
NJDEP WQC (ug/L)		9	600	600	75	30	6	NA	300	6	9	600	600	75	50	300
Region 6 Tap Water PRG (ug/L)		**8.16**	**49.3**	**14.5**	**0.467**	**146**	**11.8**	**3.36**	**6.2**	**3.4**	**8.16**	**49.3**	**14.5**	**0.467**	**91.3**	**6.2**
Sample ID	**Sample Date**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**	**Result (ug/L) Flag**
6-MW-01-GU-P-02	**2/14/07**	7700	22000	200	510	220		160	65	12	9900	32000		820 J	7700	
6-MW-02-GU-P-02	**2/13/07**	2200	3700	45	90				11		2800	5200	63	49 J	720	19 J
6-MW-03-GU-P-02	**2/13/07**	390	2200	15	35						450	2800			750	
6-MW-04-GU-P-02	**2/14/07**	4700	8000	110	320	260		64	32	62	5900	11000	170 J	490 J	2800	
6-MW-05-GU-P-02	**2/13/07**	98	720	110	120		12				89	760	120	120	210	
6-MW-06-GU-P-02	**2/13/07**				3 J									2.7 J		
6-MW-07-GU-P-02	**2/14/07**	1500	1000	130	72		12	5.8 J	46		2300	1500	180	120	330	62 J
AVERAGE		***2765***	***6270***	***102***	***164***	***240***	***12***	***77***	***39***	***37***	***3573***	***8877***	***133***	***267***	***2085***	***41***

Notes:

NA = Not Applicable
PRG = Preliminary Remediation Goal
µg/L = micrograms per liter
WQC = Water Quality Criteria
J = Estimated result
All samples are unfiltered

Table 6-34
Isotopic and Total Uranium Results for Surface Water, AOC 6

Sample ID	Sample Date	U-234		U-235		U-238		Uranium (Total)		
		Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L)	Results (µg/L) Flag	TPU [+/- 2σ]
6-SW-01-S-P-01	**5/10/06**	0.19 J	0.1	0.01 U	0.051	0.12 J	0.082	0.25	0.37 J	0.17
6-SW-02-S-P-01	**5/10/06**	87 J	16	4.4 J	1	87 J	16	177	265 J	32
6-SW-13-SW-P-00	**7/11/07**	0.5	0.14	0.005 U	0.03	0.43	0.13	0.88	1.32	0.26
6-SW-04-SW-P-00	**7/11/07**	0.213	0.081	0.011 U	0.026	0.147 LT	0.066	0.3	0.4 LT	0.14
6-SW-12-SW-P-00	**7/11/07**	0.33	0.12	0.017 U	0.038	0.39	0.13	0.79	1.18	0.27
6-SW-11-SW-P-00	**7/11/07**	0.51	0.14	0.032 U	0.039	0.44	0.13	0.9	1.35	0.26
6-SW-10-SW-P-00	**7/11/07**	0.74	0.18	0.027 U	0.036	0.57	0.15	1.17	1.75	0.31
6-SW-09-SW-P-00	**7/11/07**	0.91	0.21	0.082 LT	0.053	0.99	0.22	2.02	3.03	0.45
6-SW-08-SW-P-00	**7/11/07**	0.64	0.17	0.013 U	0.03	0.63	0.16	1.28	1.92	0.34
6-SW-07-SW-P-00	**7/11/07**	0.38	0.12	0.022 U	0.031	0.37	0.12	0.76	1.14	0.24
6-SW-06-SW-P-00	**7/11/07**	0.126 LT	0.067	0.017 U	0.031	0.115 LT	0.061	0.24	0.36 LT	0.13
6-SW-05-SW-P-00	**7/11/07**	0.116 LT	0.059	0.012 U	0.028	0.096 LT	0.054	0.2	0.3 LT	0.11

Notes:

pCi/L = picoCuries per liter

TPU = Total Propagated Uncertainty

µg/L = micrograms per liter

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

U = Result is less than the sample specific MDC

pCi/L results are converted to µg/L by dividing the result by a single point conversion factor (CF) of 0.667. This CF is consistent with the EPA published 2000 MCL rule. The rule establishes relationship between gross alpha and mass spec results.

Shading indicate results above 30 µg/L

Table 6-35
Total Uranium Results for Sediment, AOC 6

		Offsite Gamma Spectroscopy		
		Uranium (Total)		
Sample ID	Sample Date	Result (pCi/g) Flag	TPU [+/- 2σ]	MDC
6-SD-01-D-P-01	5/10/06	0 U	1.4	2.5
6-SD-02-D-P-01	5/10/06	13	3.3	3.7
6-SD-03-D-P-01	5/10/06	0.3 U	1.4	2.4
6-SD-04-SD-P-00	7/9/07	0.47	0.14	0.04
6-SD-05-SD-P-00	7/9/07	0.31	0.1	0.02
6-SD-06-SD-P-00	7/9/07	0.67	0.17	0.05
6-SD-07-SD-P-00	7/9/07	1.03	0.22	0.04
6-SD-08-SD-P-00	7/9/07	1.65	0.34	0.05
6-SD-09-SD-P-00	7/9/07	0.81	0.19	0.06
6-SD-10-SD-P-00	7/9/07	2.94	0.53	0.04
6-SD-11-SD-P-00	7/9/07	**18.4**	3	0
6-SD-12-SD-P-00	7/9/07	3.97	0.73	0.05
6-SD-13-SD-P-00	7/9/07	0.7	0.17	0.03

Notes:

MDC = Minimum Detectable Concentration

pCi/g = picoCuries per gram

U = Result is less than the sample specific MDC

Results in **bold** represent samples higher than 14 pCi/g

Table 6-36
Radiochemical Results for Surface Water, AOC 6

		GROSS ALPHA		GROSS BETA		Ra-226		Ra-228		Th-228		Th-230		Th-232	
	MCL	15		NA		5 (combined Ra226/228)		5 (combined Ra226/228)		NA		NA		NA	
Sample ID	Sample Date	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]	Result (pCi/L) Flag	TPU [+/- 2σ]
6-SW-01-S-P-01	5/10/06	0.66 U	0.73	6.8 J	1.8	0.082 U	0.063	0.21 U	0.33	0.039 U	0.051	-0.043 U	0.05	0.006 U	0.018
6-SW-02-S-P-01	5/10/06	89 J	15	83 J	14	0.17 J	0.091	0.64 U	0.4	0.042 U	0.035	0.002 U	0.061	0.015 J	0.02
6-SW-04-SW-P-00	7/11/07	2.6 LT	1.1	7.7	2.3	0.08 U	0.1	0.59 U	0.51	-0.017 U	0.052	0.013 U	0.052	0.032 U	0.027
6-SW-05-SW-P-00	7/11/07	1.4 U	1.2	4.9	2	0.12 U	0.11	-0.2 U	0.44	0.029 U	0.054	0.003 U	0.051	0.004 U	0.016
6-SW-06-SW-P-00	7/11/07	1.9 LT	1	7.2	2.1	0.15 U	0.13	-0.03 U	0.42	0.002 U	0.059	0.007 U	0.052	0.008 U	0.016
6-SW-07-SW-P-00	7/11/07	1.78 LT	0.9	6.2	1.8	0.12 U	0.12	0.45 U	0.43	-0.006 U	0.056	-0.007 U	0.049	0 U	0.016
6-SW-08-SW-P-00	7/11/07	3.8	1.4	10.3	2.5	0.049 U	0.081	0.25 U	0.41	-0.022 U	0.054	0.004 U	0.051	0.011 U	0.019
6-SW-13-SW-P-00	7/11/07	2.5 LT	1.1	5.2	1.7	0.054 U	0.085	0.19 U,M	0.75	0.01 U	0.1	0 U	0.064	-0.005 U	0.027
6-SW-09-SW-P-00	7/11/07	5.2	1.3	9.2	2	0.17 U	0.14	0.37 U	0.36	0.029 U	0.075	-0.029 U	0.056	0.023 U	0.027
6-SW-10-SW-P-00	7/11/07	4.3	1.5	7.9	2.2	0.13 U	0.12	0.19 U	0.33	0.021 U	0.07	-0.019 U	0.052	-0.005 U	0.018
6-SW-11-SW-P-00	7/11/07	4.8	1.2	7	1.8	0.026 U	0.073	0.14 U	0.41	-0.046 U	0.066	0.058 U	0.064	0.002 U	0.017
6-SW-12-SW-P-00	7/11/07	3.3	1.3	5.4	1.8	0.09 U	0.11	0.12 U,M	0.71	0.046 U	0.073	0.065 U	0.059	0.014 U	0.021

Notes:

MCL = Maximum Contaminant Level

TPU = Total Propagated Uncertainty

J = Estimated result

LT = Result is less than requested MDC but greater than sample specific MDC

M = The requested MDC not met

U = Result is less than the sample specific MDC

Shading indicate detected concentrations which equal or exceed the MCLs

Table 6-37
Radiochemical Results for Sediment, AOC 6

Sample ID	Sample Date	Ra-226 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-230 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	Th-234 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-234 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
6-SD-01-D-P-01	5/10/06	0.16	U	0.21	0.47	0.274		0.095	0.094	0.01	U	0.7	1.24				
6-SD-02-D-P-01	5/10/06	0.62	U	0.24	0.41	0.268		0.091	0.092	6.3		1.6	1.8				
6-SD-03-D-P-01	5/10/06	0.25	U	0.16	0.32	0.315		0.093	0.082	0.12	U	0.67	1.18				
6-SD-04-SD-P-00	7/9/07	0.12	U	0.25	0.42	0.208		0.067	0.064	2.7	U,M	6.1	10.4	0.209		0.064	0.009
6-SD-05-SD-P-00	7/9/07	0.24	U	0.19	0.41	0.255		0.074	0.063	0.4	U,M	3.2	5.8	0.21		0.061	0.008
6-SD-06-SD-P-00	7/9/07	0.22	U	0.18	0.36	0.32		0.084	0.063	-0.5	U,M	8.2	14.9	0.308		0.081	0.039
6-SD-07-SD-P-00	7/9/07	0.45	LT,TI	0.18	0.33	0.268		0.075	0.062	-0.9	U	1.3	2.5	0.421		0.095	0.018
6-SD-08-SD-P-00	7/9/07	0.3	LT,TI	0.17	0.29	0.232		0.068	0.062	-1.1	U,M	4.6	8.4	0.67		0.14	0.02
6-SD-09-SD-P-00	7/9/07	0.27	U	0.17	0.32	0.177		0.061	0.066	-0.17	U	0.86	1.54	0.435		0.098	0.024
6-SD-10-SD-P-00	7/9/07	0.3	U	0.16	0.38	0.289		0.077	0.06	-0.3	U,M	6.3	11.2	1.39		0.25	0.02
6-SD-11-SD-P-00	7/9/07	1.6	G	0.33	0.42	1.04		0.22	0.08	9.7	M3,G	5.5	8	8.8		1.4	0
6-SD-12-SD-P-00	7/9/07	0.33	U	0.18	0.36	0.43		0.11	0.07	0.6	U,M	3.9	6.8	2.02		0.37	0.03
6-SD-13-SD-P-00	7/9/07	0.35	LT	0.14	0.32	0.5		0.11	0.06	0.6	U	1.1	1.8	0.51		0.11	0.02

Sample ID	Sample Date	U-235 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-235 Gamma Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC	U-238 Alpha Spec Result (pCi/g)	Flag	TPU [+/- 2σ]	MDC
6-SD-01-D-P-01	5/10/06					0.13	U	0.26	0.43				
6-SD-02-D-P-01	5/10/06					0.54	U	0.41	0.63				
6-SD-03-D-P-01	5/10/06					-0.07	U	0.23	0.43				
6-SD-04-SD-P-00	7/9/07	0.011	U	0.014	0.021	-0.02	U	0.33	0.62	0.232		0.068	0.018
6-SD-05-SD-P-00	7/9/07	0.009	U	0.013	0.023	-0.14	U	0.3	0.59	0.149		0.049	0.008
6-SD-06-SD-P-00	7/9/07	0.022	U	0.021	0.032	-0.06	U	0.43	0.79	0.325		0.083	0.024
6-SD-07-SD-P-00	7/9/07	0.045	LT	0.026	0.021	-0.15	U	0.29	0.57	0.51		0.11	0.02
6-SD-08-SD-P-00	7/9/07	0.049	LT	0.03	0.03	0.15	U	0.28	0.47	0.81		0.17	0.02
6-SD-09-SD-P-00	7/9/07	0.029	LT	0.02	0.02	-0.1	U	0.21	0.4	0.396		0.092	0.031
6-SD-10-SD-P-00	7/9/07	0.043	LT	0.023	0.016	0.25	U	0.34	0.55	1.44		0.26	0.02
6-SD-11-SD-P-00	7/9/07	0.71		0.15	0.02	0.5	U,G	0.4	0.61	9		1.5	0
6-SD-12-SD-P-00	7/9/07	0.108		0.045	0.021	0.29	U	0.33	0.53	1.94		0.36	0.02
6-SD-13-SD-P-00	7/9/07	0.041	LT	0.025	0.018	0.29	U	0.24	0.37	0.341		0.084	0.015

Notes:

MDC = Minimum Detectable Concentration
pCi/g = picoCuries per gram
TPU = Total Propagated Uncertainty
G = Sample density differs by more than 15% of LCS density: sample results may be biased
LT = Result is less than requested MDC but greater than sample specific MDC
M = The requested MDC not met
TI = Nuclide identification is tentative
U = Result is less than the sample specific MDC

Table 6-38
Metals and Organics Exceeding Preliminary Remediation Goals for Surface Water, AOC 6

		Sample ID	6-SW-04-SW-P-00		6-SW-05-SW-P-00		6-SW-06-SW-P-00		6-SW-07-SW-P-00		6-SW-08-SW-P-00		6-SW-09-SW-P-00		6-SW-10-SW-P-00		6-SW-11-SW-P-00		6-SW-12-SW-P-00		6-SW-13-SW-P-00	
		Sample Date	7/11/07		7/11/07		7/11/07		7/11/07		7/11/07		7/11/07		7/11/07		7/11/07		7/11/07		7/11/07	
	NJDEP (Fresh) SWC (µg/L)	Region 6 PRG (µg/L)	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag	Result (µg/L)	Flag
MET																						
LEAD	**5**	**15**	16				18				47		27		26		20		230			
SVOA																						
BENZO(B)FLUORANTHENE	**0.038**	**0.0295**	3.8	J																		
BENZO(K)FLUORANTHENE	**0.38**	**0.295**	3.8	J																		
VOA																						
BENZENE	**0.15**	**0.354**	0.6	J	0.54	J	0.53	J	0.5	J	0.48	J										
CARBON TETRACHLORIDE	**0.33**	**0.171**	1.1		1		1		0.82	J	0.93	J	0.3	J	0.52	J	0.47	J	0.32	J	0.43	J
CHLOROFORM	**68**	**0.167**	0.51	J	0.42	J	0.42	J	0.4	J	0.35	J	0.2	J	0.29	J	0.28	J	0.25	J	0.24	J

Notes:

PRG = Preliminary Remediation Goal
SWC = Surface Water Criteria
µg/L = micrograms per liter
J = Estimated result

Table 6-39
Metals and Organics Exceeding Preliminary Remediation Goals for Sediment, AOC 6

			Sample ID	6-SD-04-SD-P-00		6-SD-05-SD-P-00		6-SD-06-SD-P-00		6-SD-07-SD-P-00		6-SD-08-SD-P-00		6-SD-09-SD-P-00		6-SD-10-SD-P-00		6-SD-11-SD-P-00		6-SD-12-SD-P-00		6-SD-13-SD-P-00	
			Sample Date	7/9/07		7/9/07		7/9/07		7/9/07		7/9/07		7/9/07		7/9/07		7/9/07		7/9/07		7/9/07	
Analyte	NJDEP SED LEL	Region 6 PRG		Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag	Result (mg/L)	Flag
METALS (mg/kg)																							
ARSENIC	6	**0.39**		*3.9*		*4.7*						*3.1*		*3.7*		*3.6*		*18*		*7.6*		*9.2*	
CHROMIUM	NA	**30.1**																*66*					
PAHs (µg/kg)																							
BENZO(A)ANTHRACENE	320	**148**						*360*	B					*370*	B	*340*	B	*4200*	B	*160*	B		
BENZO(A)PYRENE	370	**14.8**		*89*		*71*		*360*		*60*		*120*		*200*		*370*		*3800*		*150*		*38*	
BENZO(B)FLUORANTHENE	NA	**148**		*240*		*210*		*990*				*310*		*650*		*850*		*7600*		*420*			
BENZO(K)FLUORANTHENE	240	**1480**																*2400*					
DIBENZO(A,H)ANTHRACENE	60	**14.8**		*17*	J			*53*		*19*	J	*100*		*33*		*62*		*540*		*32*			
INDENO(1,2,3-CD)PYRENE	200	**148**						*160*								*190*		*2600*					
PCBs (µg/kg)																							
AROCLOR-1260	5	**222**						*260*										*310*					

Notes:

LEL = Lowest Effects Level
mg/kg = milligrams per kilogram
PRG = Preliminary Remediation Goal
SED = Sediment
µg/kg = micrograms per kilogram
mg/L = milligrams per liter
B = Analyte is detected as a blank as well as sample
J = Estimated result

Table 7-1
Uranium Decay Chain --- Main Branch [1]

Read from left to right. Arrows indicate decay.

Uranium-238 ==> (half-life: 4.46 billion years) alpha decay	Thorium-234 ==> (half-life: 24.1 days) beta decay	Protactinium-234m ==> (half-life: 1.17 minutes) beta decay
Uranium-234 ==> (half-life: 245,000 years) alpha decay	Thorium-230 ==> (half-life: 77,000years) alpha decay	Radium-226 ==> (half-life: 1,600 years) alpha decay
Radon-222 ==> (half-life: 3.82 days) alpha decay	Polonium-218 ==> (half-life: 3.11 minutes) alpha decay	Lead-214 ==> (half-life: 26.8 minutes) beta decay
Bismuth-214 ==> (half-life: 19.9 minutes) beta decay	Polonium-214 ==> (half-life: 163 microseconds) alpha decay	Lead-210 ==> (half-life: 22.3 years) beta decay
Bismuth-210 ==> (half-life: 5.01 days) beta decay	Polonium-210 ==> (half-life: 138 days) alpha decay	Lead-206 (stable)

Notes:

[1] *Small branching fractions representing less than 0.2% are not shown.*

Table 8-1

Summary of Findings: Operable Unit 1, Building 845 Area and F Corral – Soils, Concrete, and Sediment

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
SOILS: OU 1 AOC 1, Building 845 Area		
Confirm historical results of potential radiological contamination and further define surface and subsurface soil MED-related radiological contamination in OU 1, AOCs 1 and 2.	▪ RI sampling results are consistent with and confirm the earlier 1983 BNI study (Bechtel, 1985) that showed areas with highest uranium activity associated with the "Uranium Oxide Area" located to the east of former Building 845. RI results from this area indicate uranium concentrations between 15 pCi/g (1-SB-02) and 27,600 pCi/g (1TP018). ▪ Vertical extent reported in the Bechtel study was 1-3 feet bgs. RI results confirm that residual uranium contamination is shallow and typically within the first 2 ft bgs to the east and west of the building footprint; 4 ft bgs beneath the building; and 4.5 ft bgs within the Uranium Oxide Area (loading dock area to the east of building).	▪ No data limitations ▪ RI project goals met
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ 56 soil borings and 130 soil boring samples, 7 concrete samples and 17 test pit samples collected ▪ 24 test pits excavated ▪ No surface water or sediment exists in AOC 1	▪ No data limitations ▪ RI project goals met
Define the horizontal and vertical extent of MED-related contamination in AOC 1 and AOC 2 using the ISV. Previous historical investigations indicate that MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. An ISV of 14 pCi/g of total uranium in soils (7 pCi/g U-238) has been established and used to guide the investigation (Cabrera 2003c, Sec. 4.4.1). Additional ROPCs (Ra-226 and Th-230) were subsequently added to the list of eligible FUSRAP contaminants.	<u>Horizontal Extent</u> ▪ The uranium source area is identified as the footprint of the former Building 845 (foundation and elevator shaft remain after building was demolished in 1999). ▪ Impacted soil above the ISV is identified primarily within the Building 845 footprint and immediate vicinity with the exception of a few isolated surface areas. ▪ Highest uranium concentrations are found in the area of the former loading dock ("Uranium Oxide Area") and elevator shaft. ▪ Isolated areas of shallow residual contamination (primarily to depths of 1 foot bgs) were identified in the northern portion of AOC 1, in the wooden trough (part of OU 2) and an isolated area approximately 280 feet southwest of the Elevator Shaft (location of a former storage shed). ▪ The location of the former storage shed showed elevated surface uranium concentrations (149 pCi/g) at a depth of 1 foot bgs (1BH018). ▪ The horizontal extent of contamination was defined by the remaining perimeter sample locations. The ISV was not exceeded in the outer perimeter locations with the exception of isolated surface samples (1 foot bgs depth) at 1BH018 and a few sample locations at the northern tip of AOC 1 (associated with the CDD) and in the wooden trough (1BH026, 1BH027, 1BH003, and 1BH029). ▪ Area of impacted soil is approximately 1.1 acres.	▪ Horizontal delineation is completed. In areas where outermost boring exceeds the ISV, adjacent AOC samples have bounded the limits of contamination (AOC 2 samples bound elevated uranium in the southwestern portion of AOC 1; AOC 3 samples assist in bounding contamination to the north and east. Three discrete areas are impacted above the ISV.

Table 8-1

Summary of Findings: Operable Unit 1, Building 845 Area and F Corral – Soils, Concrete, and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily at shallow depths (less than 4.5 feet bgs) in the area of the former Building 845. ▪ The highest U concentration was observed to be 27,600 pCi/g at 1.5 feet bgs (1TP018) in the area of the former loading dock.	▪ No data limitations ▪ Vertical delineation completed.
Collect sufficient number of samples to evaluate the mobility of the radionuclides of potential concern	▪ XRD/SEM analysis of the yellow material sample from AOC 1 indicated the presence of metastudite and uranophane, which are somewhat soluble and mobile.	
Identify potentially co-disposed radioactive contaminants	In general, elevated Ra-226 and Th-230 concentrations (above background concentrations) were identified at locations within or in close proximity to uranium source areas. Ra-226 results in soil range from 0.4 [+/- 0.2] to 2.3 [+/- 0.5] pCi/g (15 samples). The maximum Ra-226 result was from location 1-MW-22-B-P-01 located in the area of a former storage shed. Th-230 results in soil range from 0.4 [+/- 0.1] to 64 [+/- 11] pCi/g (21 samples). Maximum Th-230 results were found in the area of the loading dock (1BH036), former Building 845.	▪ No data limitations ▪ RI project goals met
SOILS: OU 1 AOC 2, F Corral		
Confirm historical results of potential radiological contamination and further define surface and subsurface soil MED-related radiological contamination in OU 1, AOCs 1 and 2.	▪ RI sampling results are consistent with and confirm the earlier 1983 BNI study (Bechtel, 1985) that showed areas with highest uranium activity associated with locations within and immediately west of the demolished Building 708. ▪ Vertical extent reported in the Bechtel study was to a depth of 8 feet bgs with highest activity between 2-4 foot bgs. RI results confirm that elevated concentrations of uranium were reported in general at depths up to 8 feet bgs. The highest activities were in the 2-4 foot sample depths. ▪ The exception is seen in soils from 2-MW-03 (located within the footprint of Building 708) with elevated uranium concentrations reported to a depth of 11 feet bgs.	▪ No data limitations ▪ RI project goals met
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ 63 soil borings and 230 soil boring samples and 4 concrete samples were collected from three boring locations. ▪ Two test pits excavated; no soil samples obtained. ▪ No surface water or sediment was present in AOC 2.	▪ No data limitations ▪ RI project goals met

Table 8-1

Summary of Findings: Operable Unit 1, Building 845 Area and F Corral – Soils, Concrete, and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
Define the horizontal and vertical extent of MED-related contamination in AOC 1 and AOC 2 using the ISV. Previous historical investigations indicate that MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. An ISV of 14 pCi/g of total uranium in soils (7 pCi/g U-238) has been established and used to guide the investigation (Cabrera 2003c, Sec. 4.4.1). Additional ROPCs (Ra-226 and Th-230) were subsequently added to the list of eligible FUSRAP contaminants.	<u>Horizontal Extent</u> ▪ The uranium source area is identified as the footprint of the former Building 708. ▪ Impacted soil above the ISV is identified primarily within the Bldg 708 footprint and immediate area. ▪ Perimeter grid samples defined the horizontal extent of contamination in AOC 2. The ISV was not exceeded in the outer perimeter grid locations. ▪ Samples taken from locations in the vicinity of the CDD show uranium concentrations above the ISV (2BH043, 2BH042, 2BH020, 2-MW-20A) ▪ Locations where the ISV for total uranium was exceeded are located within or adjacent to the source zone (former Building 708 or the residual surface contamination where the drainage ditch discharges to CDD). <u>Vertical Extent</u> ▪ RI results indicate that soils exceeding the ISV are found primarily beneath the building footprint at depths between 0-8 feet bgs. ▪ The highest total uranium concentration was 16,600 pCi/g at 3 feet bgs within the Dissolved Uranium Source Area (2BH038). ▪ Maximum vertical extent of contamination in AOC 2 soils is 12 feet bgs. Samples from 2-MW-25 bound the maximum vertical extent.	▪ No data limitations ▪ Horizontal and vertical extent delineated
Collect sufficient number of samples to evaluate the mobility of the radionuclides of potential concern	▪ XRD/SEM analysis from samples in AOC 2 indicated that forms of uranium encountered were black oxide and brown oxide. The identified phases exhibit low solubility and low mobility. Although high concentrations of dissolved uranium indicate the presence of metastudite which is more soluble.	
Identify potentially co-disposed radioactive contaminants	In general elevated Ra-226 and Th-230 concentrations (above background concentrations) were identified at locations within or in close proximity to uranium source areas. Ra-226 results in soil range from 0.4 [+/- 0.2] to 2.9 [+/- 0.5] pCi/g (24 samples); Th-230 results in soil range from 0.19 [+/- 0.7] to 32 [+/- 5] pCi/g (20 samples). Maximum concentrations of Ra-226 (2-MW-23B) and Th-230 (2BH018) were found in the vicinity of the former Building 708 source area.	▪ No data limitations ▪ RI project goals met

Table 8-1

Summary of Findings: Operable Unit 1, Building 845 Area and F Corral – Soils, Concrete, and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
AOCs 1 and 2		
Collect adequate number of systematic grid and biased samples and obtain analytical results from both onsite and offsite laboratories for the required precision and accuracy to perform the risk evaluation using the appropriate radiological model.	**AOCs 1 and 2** ▪ Grid and biased sampling points were completed as specified in Final Field Sampling Plans and QAPP ▪ On-site gamma spectroscopy Laboratory: evaluations of the accuracy of the onsite gamma spectroscopy laboratory indicate that the screening data are sufficiently accurate to support decisions regarding nature and extent and future CERCLA actions. There was no significant bias identified in onsite and offsite sample pairs, and the majority of the results passed statistical testing (as shown in Section 2 and Appendix M). ▪ The precision of the onsite laboratory was supported by the comparison of sample duplicates. Sample duplicates passed the statistical test. ▪ Only offsite laboratory results were used for the risk assessment ▪ Offsite Radiological Laboratory: the comparison of offsite laboratory gamma and alpha spectroscopy results for soils, indicate in general that the two techniques are in good agreement and are good indicators of the actual uranium activity concentration. ▪ The statistical evaluation between on-site and off-site gamma spectroscopy laboratory results showed that a significant positive correlation exists between the two results for total uranium. ▪ Eberline and Paragon Analytics were the primary analytical laboratories for work performed in OU 1.	▪ No data limitations ▪ RI project goals met
Characterize background concentrations of naturally-occurring radionuclides that are FUSRAP eligible contaminants	**AOCs 1 and 2** ▪ Background concentrations were evaluated onsite at Chambers Works outside the area of any MED/FUSRAP OUs/AOCs. The methodology and results of the background evaluation are presented in Section 9. The location of the background reference area is shown on Figure 1-2 and Figure 9-1. Sample ID numbers in the background reference area start with a "7" to designate this area and distinguish it from the six FUSRAP Areas of Concern. Data comparison of field sampling results with background concentrations are presented in the baseline risk assessment, Appendix B.	▪ No data limitations ▪ RI project goals met
Establish and confirm relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.	**AOCs 1 and 2** ▪ Additional sample locations were identified and sampled to evaluate the relationship of RA-226, Th-230, and U-238. In general, elevated Ra-226 and Th-230 concentrations were found in source areas of uranium contamination.	▪ No data limitations ▪ RI project goals met
Address data gaps concerning the concentrations of non-eligible contaminants to characterize chemical risks for the baseline risk assessment.	**AOCs 1 and 2** ▪ 18 additional soil samples were obtained in AOC 1 ▪ 16 additional soil samples were obtained in AOC 2 ▪ All additional samples were analyzed for metals, VOCs/SVOCs PCB/PAH/Pesticide concentrations for use in baseline risk assessment	▪ No data limitations ▪ RI project goals met

Table 8-2

Summary of Findings: Operable Unit 2, Central Drainage Ditch and Building J-26 Area – Soils and Sediment

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions using the ISV	Data Limitations/ Recommendations
SOILS and SEDIMENTS: OU 2 AOC 3, Central Drainage Ditch		
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ Investigation results include the current ditch and historical location of ditch. ▪ 39 soil boring stations with 183 soil samples ▪ 13 surface water samples ▪ 30 sediment samples ▪ No concrete present in AOC 3	▪ No data limitations ▪ RI project goals met
Define the horizontal and vertical extent of MED-related contamination in AOC 3 and AOC 5 using the ISV. Previous historical investigations indicate that MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. An ISV of 14 pCi/g of total uranium in soils (7pCi/g U-238) has been established and used to guide the investigation and define the limit of potential contamination. (Cabrera 2003c, Sec. 4.4.1). Additional ROPCs (Ra-226 and Th-230) were subsequently added to the list of eligible FUSRAP contaminants.	Horizontal Extent ▪ Sediment in CDD is defined as the horizon sampled between 0-2 feet. Samples within this same horizon collected outside the midline of the CDD (banks) are defined as soil samples. ▪ The uranium source areas for AOC 3 are within OU 1 and consist of soil contamination associated with uranium processing operations at former Buildings 845 (in AOC 1) and 708 (AOC 2). ▪ Soil above the ISV is identified at three locations in the upper reaches of the CDD and east of the wooden trough (3-SB-09 (15 pCi/g), 3-SB-05 (35 pCi/g), and 3-SB-31(23 pCi/g). Two sediment samples in the wooden trough had U concentrations above the ISV (98 pCi/g at 3-SB-04 and 22 pCi/g at 3-SB-02) ▪ Uranium concentrations in the lower reaches of the CDD exceeded the ISV at six locations within the current drainage ditch, the historical run of the ditch, and to the south of the historical ditch. ▪ Sample results with uranium concentrations less than the ISV bound the northern edge of the AOC. Isolated sample locations show uranium concentrations above the ISV in the area of the wooden trough (3-SB-31) and in the CDD between AOC 1 and AOC 2 (3-SB-05) ▪ Lateral extent of contamination is limited to the historical extent of CDD. ▪ Northern extent of contamination has been defined by soil sample results below the ISV.	Horizontal delineation identifies three discrete areas where soils are contaminated above the ISV: the wooden trough; the lower reaches of the CDD near the western boundary of the historical lagoon and a discrete sediment sample in the middle portion (main run) of the CDD (3-SS-28 (80 pCi/g) at 0.5 feet bgs). The sediment sample at 3-SS-28 is believed to be DuPont radioactive material (fluorspar) used in the production of hydrofluoric acid based on the results of mineralogical analysis. The suite of minerals identified in this sample is consistent with fluorspar feedstock and not with MED feedstock used at Chambers Works or with naturally occurring uranium in the area.

Table 8-2

Summary of Findings: Operable Unit 2, Central Drainage Ditch and Building J-26 Area – Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions using the ISV	Data Limitations/ Recommendations
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily at shallow depths (less than 3.0 feet bgs) in the upper reaches of the CDD and 8 feet bgs in the lower reaches. ▪ The highest total uranium concentration in the upper reach was 35 pCi/g at 3.0 feet bgs (3-SB-05); 80 pCi/g at 0.5 feet bgs (3-SS-28) in the middle of the CDD; and 41 pCi/g at 7 feet bgs (3-SB-26) in the lower reach. The deepest contamination in the lower reaches was at 3-SB-20 (33.7 pCi/g) in the 6-8 ft bgs interval. ▪ Sample 3-SB-39 contained the highest uranium concentration detected in AOC 3 (365 pCi/g) This sample location was placed in the vicinity of SWMU 16, a closed DuPont disposal cell, near the berm of the historic lagoon and may not be representative of the extent of FUSRAP-related contamination within AOC 3.	▪ No data limitations ▪ Vertical delineation completed.
Collect sufficient number of samples to evaluate the mobility of the radionuclides of potential concern	▪ Sequential extraction tests on sample 3-SS-28 indicated that uranium compounds are present in the exchangeable fraction and may be mobilized where excess cations are present or in weakly acidic conditions. ▪ Mineralogical analysis of sample 3-SS-28 supports determination that sample represents fluorspar from DuPont hydrofluoric acid (HF) production.	
Identify potentially co-disposed radioactive contaminants	Elevated Ra-226 and Th-230 concentrations (above background concentrations) were identified at locations within or in close proximity to areas of uranium contamination above the ISV in soils. Ra-226 results in soil range from 0.3 [+/- 0.1] to 3.83 [+/- 0.6] pCi/g (71 samples); Th-230 results in soil range from 0.12 [+/- 0.06] to 11.2 [+/- 1.8] pCi/g (37 samples).	▪ No data limitations ▪ RI project goals met
Establish and confirm relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.	▪ Additional sample locations were identified and sampled to evaluate the relationship of Ra-226, Th-230, and U-238 and to support the risk assessment. In general, elevated Ra-226 and Th-230 concentrations were found in source areas of uranium contamination in soils.	▪ No data limitations ▪ RI project goals met
SOILS: OU 2 AOC 5, Building J-26 Area		
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ 11 soil borings and 61 soil samples were collected. ▪ Locations were primarily in drainage ditches that surround the former J-16 building in the area. Historical records indicate that soils and foundations of former Building J-16 were excavated. ▪ No concrete was present in AOC 5. ▪ No surface water or sediment was present in AOC 5.	▪ No data limitations ▪ RI project goals met

Table 8-2

Summary of Findings: Operable Unit 2, Central Drainage Ditch and Building J-26 Area – Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions using the ISV	Data Limitations/ Recommendations
Define the horizontal and vertical extent of MED-related contamination in AOC 3 and AOC 5 using the ISV. Previous historical investigations indicate that MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. An ISV of 14 pCi/g of total uranium in soils (7pCi/g U-238) has been established and used to guide the investigation and define the limit of potential contamination. (Cabrera 2003c, Sec. 4.4.1). Additional ROPCs (Ra-226 and Th-230) were subsequently added to the list of eligible FUSRAP contaminants.	Horizontal Extent ▪ No MED-related uranium was encountered in soil above the ISV in AOC 5. ▪ Highest uranium concentration was 3.38+/-2.02 pCi/g in sample 5-SB-05 (one foot bgs) Vertical Extent ▪ No MED-related uranium was encountered at depth in soil above the ISV in AOC 5. ▪ Highest uranium concentration was 2.3+/-1.4 pCi/g in sample 5-SB-05 (10 feet bgs)	▪ No data limitations ▪ RI project goals met
Identify potentially co-disposed radioactive contaminants	▪ Ra-226 results in soil range from 0.1 [+/- 0.2] to 1.4 [+/- 0.3] pCi/g (22 samples); Th-230 results in soil range from 0.2 [+/- 0.7] to 0.9 [+/- 0.2] pCi/g (11 samples). ▪ All results in AOC 5 were below background concentrations; these samples were collected during the September 2003 field activities. No additional soil sampling occurred within AOC 5.	▪ No data limitations ▪ RI project goals met
Establish and confirm relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.	▪ No additional samples were collected during the 2007 sampling effort due to the lack of radiological contamination in this AOC.	▪ No data limitations ▪ RI project goals met
Address data gaps concerning the concentrations of non-eligible contaminants to characterize chemical risks for the baseline risk assessment.	▪ No additional samples were collected during the 2007 sampling effort in AOC 5 due to lack of radiological contamination in this AOC.	▪ No data limitations ▪ RI project goals met

Table 8-2

Summary of Findings: Operable Unit 2, Central Drainage Ditch and Building J-26 Area – Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions using the ISV	Data Limitations/ Recommendations
AOC 3 and AOC 5		
Collect adequate number of systematic grid and biased samples and obtain analytical results from both onsite and offsite laboratories for the required precision and accuracy to perform the risk evaluation using the appropriate radiological model.	▪ Grid and biased sampling points were completed as specified in Final Field Sampling Plans and QAPP ▪ On-site gamma spectroscopy laboratory: evaluations of the accuracy of the onsite gamma spectroscopy laboratory indicate that the screening data is sufficiently accurate to support decisions regarding nature and extent and future CERCLA actions. There was no significant bias identified in onsite and offsite sample pairs, and the majority of the results passed statistical testing (as discussed in section 2 and Appendix M). ▪ The precision of the onsite laboratory was supported by the comparison of sample duplicates. Sample duplicates passed the statistical test. .	▪ No data limitations ▪ RI project goals met
	▪ Offsite Radiological Laboratory: the comparison of offsite laboratory gamma and alpha spectroscopy results for soils, indicate in general that the two techniques are in good agreement and are good indicators of the actual uranium activity concentration. ▪ Only offsite laboratory results were used for risk assessment purposes. Paragon Analytics was the primary analytical Laboratory for work performed in OU 2.	
Characterize background concentrations of naturally-occurring radionuclides that are FUSRAP eligible contaminants	▪ Background concentrations were evaluated onsite at Chambers Works outside the area of any MED/FUSRAP OUs/AOCs. The methodology and results of the background evaluation are presented in Section 9. The location of the background reference area is shown on Figure 1-2 and Figure 9-1. Sample ID numbers in the background reference area start with a "7" to designate this area but to distinguish it from the six FUSRAP Areas of Concern. Data comparison of field sampling results with background concentrations are presented in the baseline risk assessment, Appendix B.	▪ No data limitations ▪ RI project goals met

Table 8-3

Summary of Findings: Operable Unit 3, Historical Lagoon Area (AOC 4) and East Area (AOC 6) – Soils and Sediment

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions Using the ISV	Data Limitations/ Recommendations
SOILS: OU 3 AOC 4, Historical Lagoon Area		
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ Based on gamma walkover survey and CPT results performed around the perimeter and through the center of AOC 4, two Areas of Interest (AOIs) were identified for further investigation. AOI 1 is located in the northern part of the AOC along the shoreline of the Delaware River, in the vicinity of DuPont Solid Waste Management Unit 5 (SWMU 5); AOI 2 is located in the eastern section of the AOC in a reported MED rubble disposal area. ▪ Based on the RI results, elevated uranium was detected only in AOI 1. No elevated uranium activity was confirmed in the southern or eastern sections of AOC 4. Perimeter of the lagoon was investigated using gamma walkover surveys and cone penetrometer testing (CPT) with in-situ gamma spectroscopy at 64 locations. ▪ During the gamma walkover survey an area along the western edge of the AOC showed elevated readings which were attributed to the granitic gravel used in the area (railroad tracks). No further investigation was conducted in this area. ▪ Collected 51 soil samples from 28 stations for offsite laboratory analysis; no onsite laboratory was used during the OU 3 investigations. ▪ MED-related uranium only found in the northernmost part of the AOC (in the area of AOI 1, SWMU 5); no uranium results exceeding the ISV were confirmed in AOI 2 soils, located within the eastern portion of AOC 4. ▪ No concrete was present in AOC 4. ▪ No surface water or sediment exists in AOC 4	▪ No data limitations ▪ RI project goals met
Define the horizontal and vertical extent of MED-related contamination in AOC 4 and AOC 6 using the ISV. Previous historical investigations indicate that MED-related radiological contamination is limited to natural uranium isotopes (i.e., U-234, U-235, and U-238) and their short-lived decay progeny. An ISV of 14 pCi/g of total uranium in soils (7pCi/g U-238) has been established and used to guide the investigation and define the limit of potential contamination. (Cabrera 2003c, Sec. 4.4.1). Additional ROPCs (Ra-226 and Th-230) were subsequently added to the list of eligible FUSRAP contaminants.	<u>Horizontal Extent</u> ▪ The uranium source areas are identified as contaminated materials disposed of in the AOC. Edges of lagoon were filled in and built up with both DuPont and MED rubble/debris. Lab waste from OU 2 (Building J-26 Area) was reported to be buried in AOI 1, DuPont SWMU 5. ▪ Soil above the ISV is identified at seven locations in AOI 1 with six of the seven locations in the area of the disposal cell (SWMU 5), south of the slurry wall. One location to the north of AOI 1 (4-MW-05) showed an uranium concentration only slightly above the ISV at 15 pCi/g (3 feet bgs). ▪ No results exceeding the ISV were confirmed in AOI 2 soils, located within the eastern portion of AOC 4.	▪ No data limitations ▪ Horizontal delineation is completed. Three discrete areas have uranium concentrations above the ISV.

Table 8-3

Summary of Findings: Operable Unit 3, Historical Lagoon Area (AOC 4) and East Area (AOC 6) –Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions Using the ISV	Data Limitations/ Recommendations
	Vertical Extent ▪ RI results indicate that soils exceeding the ISV are found primarily within the upper 10 feet bgs. ▪ Highest uranium concentration in soil at AOI 1 was 355 [+/-60] pCi/g at 8 feet bgs (4-MW-06A). ▪ No exceedance of the ISV was confirmed in AOI 2 soils.	Vertical delineation complete in area of AOI 1.
Identify potentially co-disposed radioactive contaminants	In general, elevated Ra-226 and Th-230 concentrations (above background concentrations) were identified at locations within and in close proximity to uranium source areas. Ra-226 results in soil range from 0.2 [+/- 0.3] to 4.4 [+/- 0.7] pCi/g (51 samples); Th-230 results in soil range from 0.5 [+/- 0.1] to 26 [+/- 4] pCi/g (20 samples). The maximum Ra-226 and Th-230 concentrations (4.4 and 26.4 pCi/g) were from the location 4-MW-06 which showed an elevated uranium concentration of 355 pCi/g. This location is within the source area of AOI 1, SWMU 5 Area.	▪ No data limitations ▪ RI project goals met
Address data gaps concerning the concentrations of non-eligible contaminants to characterize chemical risks for the baseline risk assessment.	▪ 20 soil samples were obtained in AOC 4 ▪ No surface water or sediment present in AOC 4 ▪ All samples analyzed for metals, VOCs/SVOCs. ▪ PCBs/PAHs/Pesticides samples obtained for use in baseline risk assessment	▪ No data limitations ▪ RI project goals met
SOILS: OU 3 AOC 6, East Area		
Characterize each OU by collecting sufficient samples (soil, concrete, sediment, and surface water) to adequately confirm the presence and extent of uranium concentrations greater than the ISV.	▪ Seven AOIs were identified through historical records search and surveyed using gamma walkover surveys and cone penetrometer testing (CPT) with in-situ gamma spectroscopy at 49 locations. ▪ One AOI was identified for further investigation (AOI 4). AOI 4 is the location of a disposal area used for MED scrap/waste and DuPont radioactive waste. ▪ During the gamma walkover survey an area under East Road was identified for further investigation. ▪ Collected 91 soil samples from 49 stations for offsite laboratory analysis. ▪ Collected 12 sediment and 12 surface water samples in the ditch located north of East Road. ▪ MED uranium was found in the area under East Road (source area). ▪ No concrete was present in AOC 6.	▪ No data limitations ▪ RI project goals met

Table 8-3

Summary of Findings: Operable Unit 3, Historical Lagoon Area (AOC 4) and East Area (AOC 6) – Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions Using the ISV	Data Limitations/ Recommendations
	Horizontal Extent ▪ The uranium source area is identified as East Burial Area currently located under East Road. MED scrap and waste were buried there with DuPont radioactive waste. ▪ Soil above the ISV is identified primarily under East Road, in an area directly north of East Road, and in an area to the northeast of the source zone. 13 locations in the area of East Road; 5 locations north of East Road; 4 locations northeast of the source zone in AOI 4. ▪ Maximum U concentration in soil in AOI 4 was 3910 [+/- 460] pCi/g at 1 foot bgs under East Road (6-SB-04). ▪ One grab sample from the bank of the ditch was collected at 6-CPT-62A and reported 1280 pCi/g at 1 foot bgs. ▪ Highest sediment sample from the source zone was 18 pCi/g [+/- 3]; all remaining sediment samples upstream and downstream were below the ISV, ranging from 0.7 – 13 pCi/g total uranium. ▪ Area impacted above the ISV is approximately 0.1 acres.	▪ No data limitations ▪ RI project goals met
	Vertical Extent ▪ ISV exceedances reported in 18 samples in AOI 4, to a depth of 4 foot bgs. ▪ Highest activity in AOI 4 at 1 foot bgs was 3,910 [+/- 460] pCi/g ▪ Five exceedances in AOI 6 between 6 and 12 feet bgs, ranged from 37.3 pCi/g to 153 pCi/g.	▪ No data limitations ▪ RI project goals met
Identify potentially co-disposed radioactive contaminants	In general, elevated Ra-226 and Th-230 concentrations (above background concentrations) were identified at locations within or in close proximity to sources of uranium contamination in soil. Ra-226 results in soil range from 0.3 [+/- 0.3] to 14.3 [+/- 1.8] pCi/g (71 samples); Th-230 results in soil range from 0.17 [+/- 0.07] to 69 [+/- 0.2] pCi/g (29 samples). Maximum concentrations of Ra-226 (6-SB-04) and Th-230 (6-SB-38) were found in the source area of uranium contamination in AOC 6 (under East Road). Elevated uranium concentrations were also encountered at these locations.	▪ No data limitations ▪ RI project goals met
Establish and confirm relationship of Ra-226 and Th-230 concentrations with respect to MED uranium concentrations.	▪ Additional sample locations were identified and sampled to evaluate the relationship of Ra-226, Th-230, and U-238. The majority of the radiological isotopes were collocated with uranium in soils.	▪ No data limitations ▪ RI project goals met
Address data gaps concerning the concentrations of non-eligible contaminants to characterize chemical risks for the baseline risk assessment.	▪ 20 soil samples were obtained in AOC 6 ▪ 12 surface water sample were obtained in AOC 6 ▪ 13 sediment samples were obtained in AOC 6 ▪ All samples analyzed for metals, VOCs/SVOCs. PCB/PAH/Pesticide samples obtained for use in baseline risk assessment	▪ No data limitations ▪ RI project goals met

Table 8-3

Summary of Findings: Operable Unit 3, Historical Lagoon Area (AOC 4) and East Area (AOC 6) – Soils and Sediment (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions Using the ISV	Data Limitations/ Recommendations
	AOC 4 and AOC 6	
Collect adequate number of systematic grid and biased samples and obtain analytical results from offsite laboratory for the required precision and accuracy to perform the risk evaluation using the appropriate radiological model.	▪ Grid and biased sampling points were completed as specified in Final Field Sampling Plans and QAPP. ▪ Offsite Radiological Laboratory: the comparison of offsite laboratory gamma and alpha spectroscopy results for soils, indicate in general that the two techniques are in good agreement and are good indicators of the actual uranium activity concentration. ▪ Only offsite laboratory results were used for risk assessment purposes. Paragon Analytics was the primary analytical laboratory for work performed in OU 3.	▪ No data limitations ▪ RI project goals met
Characterize background concentrations of naturally-occurring radionuclides that are FUSRAP eligible contaminants	▪ Background concentrations were evaluated onsite at Chambers Works outside the area of any MED/FUSRAP OUs/AOCs. The methodology and results of the background evaluation are presented in Section 9. The location of the background reference area is shown on Figure 1-2 and Figure 9-1. Sample ID numbers in the background reference area start with a "7" to designate this area and distinguish it from the six FUSRAP Areas of Concern. Data comparison of field sampling results with background concentrations are presented in the baseline risk assessment, Appendix B.	▪ No data limitations ▪ RI project goals met

Table 8-4

Summary of Findings: Groundwater - Operable Units 1, 2, and 3

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
GROUNDWATER: OUs 1, 2 AND 3		
Confirm the horizontal extent of aqueous uranium in OUs 1 and 3.	▪ Monitoring well program was designed to confirm the extent of aqueous uranium and evaluate the mobility of uranium in groundwater. Results indicate that areas of groundwater contamination are contained within the boundaries of the AOCs, are located where elevated concentrations in soil are also found, and have not migrated over the last 65 years. This trend is demonstrated in the recent quarterly monitoring program results (2004-2007). ▪ In OU 1 aqueous-phase uranium was encountered in both the A and B aquifers but is observed primarily in the shallow, A aquifer. ▪ In OU 1, three discrete areas of groundwater contamination in the A aquifer have been identified with uranium concentrations exceeding the MCL of 30 µg/L (used for evaluation purposes). These areas are within the footprint of the former MED buildings (AOCs 1 and 2) and a location of a former storage shed in the southwest portion of AOC 1. ▪ MW-03B (average 29,560 µg/L) and 2-MW-05B (average 167 µg/L) ▪ In OU 1 the horizontal extent of aqueous uranium is estimated to cover approximately 0.5 acres and 0.2 acres in the A and B aquifers, respectively. ▪ In OU 3 the horizontal extent of aqueous uranium is centered on one A aquifer well in AOC 4 (I17-M01A, average 145 µg/L) and one B aquifer well in AOC 6 (6-MW-01B, average 267 µg/L).	▪ No data limitations ▪ Recommend continued routine monitoring of wells in OUs 1 and 3

Table 8-4

Summary of Findings: Groundwater - Operable Units 1, 2, and 3 (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
Confirm the vertical extent of aqueous uranium in confirmed areas of contamination (OUs 1 and 3).	▪ In OU 1 the vertical extent of uranium has been determined to be primarily in the A aquifer except for a limited area of groundwater contamination in the B aquifer in AOC 2 within the Dissolved Uranium Area (footprint of former Building 708). Sampling of the C aquifer in this area of AOC 2 has consistently shown no further vertical migration of uranium into the C aquifer. ▪ Aqueous uranium contamination in AOC 2 is observed in the area of 2-MW-03 in the B aquifer. Uranium concentrations at 2-MW-03 B have been elevated consistently over the six quarters of monitoring but downgradient movement of uranium has not been observed. However, the most recent sampling from 2-MW-05B (upgradient of 2-MW-03) indicated elevated uranium (1,019 µg/L). This was the only quarter where concentrations exceeded the MCL of 30 µg/L; the previous 4 quarters had been well below the MCL.. Additional sampling is recommended for this location to assist in defining the potential for contamination in the B Aquifer under the Former Building 708. ▪ OU 3, uranium contamination is highly localized. Elevated uranium has been detected in one well in the A aquifer, (I17-MO1A) in AOC 4 and one well in the B aquifer (6-MW-01B) in AOC 6.	▪ No data limitations ▪ Recommend continued routine monitoring of wells in OUs 1 and 3.
Determine whether there are seasonal variations in the direction or flux of the groundwater in the "A" and "B" aquifers (OUs 1, 2 and 3);	▪ Groundwater flow direction in A aquifer appears to be in a northerly direction and controlled by the CDD in OU 1 while in B aquifer, the flow direction is toward the northeast. In OU 3, AOC 4, groundwater flow direction in the A aquifer has been to the northwest towards the Delaware River. Groundwater flow direction in the B aquifer has been to the southeast. Groundwater flow in AOC 6 (B aquifer) is to the southwest presumably towards a DuPont recovery well.	▪ No data limitations ▪ Recommend continued routine monitoring of water levels to evaluate groundwater flow direction in OUs 1 and 3.
Determine the nature of tidal flux in OU 3 in AOC 4, AOI 1 (SWMU 5 Area).	▪ Pressure gauge transducers were installed in 4 wells within SWMU 5 and ran from May 17, 2006 to June 8, 2006. Data was recorded at 30 minute intervals. Transducer data indicates that the A aquifer in AOC 4 is hydraulically connected to the Delaware River. Data results are presented in Appendix Q.	▪ No data limitations ▪ RI project goals met

Table 8-4

Summary of Findings: Groundwater - Operable Units 1, 2, and 3 (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
Determine the nature of tidal flux in OU 3 in AOC 4, AOI 1 (SWMU 5 Area).	▪ Pressure gauge transducers were installed in 4 wells within SWMU 5 and ran from May 17, 2006 to June 8, 2006. Data was recorded at 30 minute intervals. Transducer data indicates that the A aquifer in AOC 4 is hydraulically connected to the Delaware River. Data results are presented in Appendix Q.	▪ No data limitations ▪ RI project goals met
Sample for other contaminants that may have been produced under MED contracts or for health and safety reasons (organic intermediates, aromatics, petroleum constituents, fluorochemicals, polymers, elastomers, thorium, and possibly specialty chemicals) (OUs 1, 2 and 3).	▪ Groundwater samples were analyzed for Ra226/228, thorium isotopes, SVOCs and VOCs. In the OU 1 A aquifer, no Ra226/228 was reported above the MCL. Thorium isotopes were detected in 3 of 37 samples. In the B aquifer, one well (2-MW-03B) contained Ra226/228 at the MCL. Thorium isotopes were detected in 5 of 36 samples but at concentrations well below the MCL. VOCs in both the OU 1 A and B aquifers were detected with the greatest frequency in four wells within each aquifer. ▪ In OU3, AOC 4, no Ra226/228 exceeded the MCL in either aquifer. Th-230 was detected in only 3 of 22 samples in the A and in one of eight samples in the B aquifer. All results were below the MCL. Four of five monitoring wells from the A aquifer were above Region VI PRGs for VOCs and all five wells had SVOCs above the PRGs. The B aquifer well H17MO2B contained BOTH elevated levels of VOCs and SVOCs. ▪ In OU3, AOC 6, no Ra226/228 exceeded the MCL and Th-230 was detected in one well but below the MCL. VOCs and SVOCs were detected above the PRGs in all seven wells.	▪ No data limitations ▪ Recommend continued routine monitoring of wells for FUSRAP-eligible contaminants.
Sample light nonaqueous phase liquid (LNAPL) for uranium (OU 1).	▪ An LNAPL sample from 2-MW-01B was analyzed for VOCs, SVOCs and total uranium. The uranium concentration was in the range of local background values; results for VOCs and SVOCs in OU 1 are provided in Section 4.0 of the RI.	▪ No data limitations ▪ RI project goals met
Evaluate uranium mobility (OUs 1, 2 and 3).	▪ Uranium mobility is evaluated for all OUs in Section 7.0 of the RI. In general, geochemical conditions in OU 2, AOC 3 indicate an oxidizing environment, which is favorable to uranium mobility. Geochemical conditions in OU 1 (AOCs 1 and 2) indicate more variability with neutral pH, high sulfate concentrations and oxidizing to slightly reducing conditions. In contrast, OU 3 conditions indicate a strongly reducing environment in which uranium is not mobile.	▪ No data limitations ▪ Recommend continued routine monitoring of wells

Table 8-4

Summary of Findings: Groundwater - Operable Units 1, 2, and 3 (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
Evaluate uranium mobility (OUs 1, 2 and 3).	▪ Uranium mobility is evaluated for all OUs in Section 7.0 of the RI. In general, geochemical conditions in OU 2, AOC 3 indicate an oxidizing environment, which is favorable to uranium mobility. Geochemical conditions in OU 1 (AOCs 1 and 2) indicate more variability with neutral pH, high sulfate concentrations and oxidizing to slightly reducing conditions. In contrast, OU 3 conditions indicate a strongly reducing environment in which uranium is not mobile.	▪ No data limitations ▪ Recommend continued routine monitoring of wells
Evaluate flow direction and gradient of the "A" aquifer (OUs 1, 2 and 3).	▪ In OU 1 groundwater flow direction in the A aquifer appears to be in a northerly direction toward the CDD. ▪ In OU 1 and OU 2 groundwater flow direction in the A aquifer is controlled by the drainage ditches. In OU 3 groundwater flow in the A Aquifer in AOC 4 is towards the Delaware River. In AOC 6 there is no A Aquifer present. All gradients are from 1 to 4 %.	
Evaluate flow direction and gradient of the "B" aquifer and vicinity (OUs 1, 2 and 3	▪ In OU 1, the flow direction of the B aquifer is toward the northeast. In OU 3, AOC 4, groundwater flow direction in the B Aquifer has been to the south or southeast. ▪ Groundwater flow in AOC 6 (B aquifer) is to the southwest towards a DuPont recovery well. The gradient in the B Aquifer in the OU 1area varied from 0.6% to 1.9%, averaging 1.4% over four quarters.	
Establish up-gradient "baseline" locations to compare with the groundwater results of the down-gradient wells, recognizing that groundwater across the DuPont Chambers site has been impacted by numerous non-FUSRAP contaminants (OUs 1, 2 and 3).	▪ Baseline wells (MW-13 and MW-14) were installed up-gradient in OU 1 for monitoring purposes.	▪ No data limitations ▪ Recommend continued routine monitoring of wells

Table 8-4

Summary of Findings: Groundwater - Operable Units 1, 2, and 3 (cont.)

RI Sampling and Analytical Project Goals	Summary of RI Findings and Conclusions	Data Limitations/ Recommendations
Evaluate the potential pathway of impacted groundwater to surface water in the drainage ditches (OUs 1, 2 and 3).	▪ In OUs 1 and 2, in the area of the CDD, water drains from the 'A' aquifer into the CDD. In OU 3, this is also a potential migration pathway, as the current groundwater flow direction and proximity of the Delaware River indicate that aqueous uranium in AOC 4 could potentially migrate northward to the Delaware River. However, DuPont has installed a recovery system and sheet-wall in OU 3-AOC 4 as part of an interim remedial action to prevent off-site contaminant migration through groundwater, and investigations indicate that no further migration is occurring. The extent of aqueous uranium contamination is within the existing boundaries of AOI 1 in the vicinity of DuPont's SWMU 5.	▪ No data limitations ▪ Recommend continued routine monitoring of wells
Achieve the required sensitivity to compare with the ISV and potential screening criteria for groundwater (drinking water standards for total uranium, total radium and gross alpha)	▪ A determination of the required sensitivity was performed as part of the QAPP and that sensitivity was achieved through use of specified laboratory method detection limits.	▪ No data limitations ▪ RI project goals met
Obtain additional site physical feature data such as observed fluctuations in water levels	▪ Routine water levels were obtained and recorded for all monitoring wells sampled in each of the OUs	▪ No data limitations ▪ Recommend continuation of routine water level measurements for each sample event
Obtain stratigraphic and hydrogeological data to better define pathways such as preferential shallow groundwater flow and the extent and nature of near-surface fill materials	▪ Stratigraphic and hydrogeologic information was obtained during drilling activities. Results have been incorporated into the appropriate text discussions throughout the RI.	▪ No data limitations ▪ RI project goals met
Determine the horizontal and vertical extent of aqueous uranium in groundwater at DuPont's Solid Waste Management Unit (SWMU) 5 (OU 3).	The extent of aqueous uranium contamination within the existing boundaries of DuPont's SWMU 5 has been identified as a zone of uranium-impacted groundwater in the A aquifer approximately 200 feet long and 150 feet wide.	▪ No data limitations ▪ Recommend continued routine monitoring of wells in OU 3.
Test for the presence of uranium peroxide dihydrate in groundwater samples (OUs 1 and 3).	▪ Hydrogen peroxide was sampled by both Hach kit and test-strip methods. Results indicate that hydrogen peroxide is present in each of the 13 A aquifer wells in OU1 in concentrations ranging from 1.0 mg/L to more than 80 mg/L. The 12 OU 1 B aquifer wells had hydrogen peroxide concentrations ranging from 1.0 mg/L to > 16 mg/L. ▪ In OU 3, hydrogen peroxide has been detected in three A aquifer wells at concentrations ranging from 2.0 mg/L (Q7, wells 4-MW-02A and 4-MW-07A) to 4.8 mg/L (Q4, well I17-MO1A). All other concentrations for these wells have been reported between 0.00) and 0.60 mg/L.	▪ No data limitations ▪ Recommend continued routine monitoring of hydrogen peroxide in OUs 1 and 3.

Table 9-1
Radionuclide Results (pCi/g) for Surface, Subsurface and All Depth Soils, Background Reference Area

Analyte	(Detected/ Total) Samples	Detected Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
Background Concentration (pCi/g) for Surface Soil							
Ra-226	10/10	1.61	0.6	N	2.062	1.728	1.61
Ra-228	8/10	0.98	0.7	X	1.115	1.01	0.98
Th-228	10/10	0.99	**0.225**	X	0.99	0.99	0.99
Th-230	10/10	1.18	0.39	N	1.437	1.188	1.18
Th-232	10/10	1	0.382	N	1.227	1.054	1
U-234	10/10	1.65	0.33	L	3.326	1.945	1.65
U-235	6/10	0.098	0.043	X	0.1	0.086	0.086
U-238	10/10	1.55	0.31	N	1.97	1.57	1.55
Background Concentration (pCi/g) for Subsurface Soil							
Ra-226	10/10	1.88	0.64	N	2.26	1.93	1.88
Ra-228	10/10	1.51	0.57	N	1.91	1.60	1.51
Th-228	10/10	1.47	0.51	N	1.91	1.63	1.47
Th-230	10/10	1.33	0.55	N	1.61	1.38	1.33
Th-232	9/10	1.39	0.53	N	1.93	1.62	1.39
U-234	10/10	1.42	0.68	N	1.61	1.38	1.38
U-235	8/10	0.108	0.046	X	0.12	0.10	0.10
U-238	10/10	1.34	0.54	N	1.61	1.37	1.34
Background Concentration (pCi/g) for All Depth Soil							
RA-226	20/20	1.88	0.60	N	2.01	1.792	1.79
RA-228	18/20	1.51	0.57	X	1.39	1.35	1.35
Th-228	20/20	1.47	**0.23**	N	1.647	1.457	1.46
Th-230	20/20	1.33	0.39	N	1.44	1.28	1.28
Th-232	20/20	1.39	0.38	N	1.56	1.389	1.39
U-234	20/20	1.65	0.33	N	1.729	1.5	1.50
U-235	14/20	0.11	0.04	X	0.09	0.09	0.09
U-238	20/20	1.55	0.31	N	1.64	1.439	1.44

Notes:

BKGD = Background

Dist = Distribution

ND = Not determined (Detected sample<5)

pCi/g = Piccocuries per gram

UTL = Upper Tolerance Limit

UPL = Upper Prediction Limit

L = Lognormal

N = Normal

X = Neither normal nor lognormal

The highlighted are outliers at 5% significance level (By using Dixon's outlier test)

For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.

For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-2
Toal Metal Results (mg/kg) for Surface, Subsurface and All Depth Soils, Background Reference Area

Analyte	(Detected/ Total) Samples	Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
Background Concentration (mg/kg) for Surface Soil							
ALUMINUM	10/10	**19000**	5400	L	25985	18049	18049
ANTIMONY	0/10	2.4	2.1	ND	ND	ND	ND
ARSENIC	10/10	**5.5**	1.5	L	6.91	4.95	4.95
BARIUM	10/10	160	24	L	234.7	140.0	140
BERYLLIUM	4/10	1	0.55	X	1.07	0.93	0.93
CADMIUM	2/10	1.4	0.92	ND	ND	ND	1.4
CHROMIUM	10/10	19	11	N	22.94	20.14	19
COBALT	10/10	**2900**	3.2	X	2900	2900	2900
COPPER	10/10	48	3.1	L	175.80	69.26	48
IRON	10/10	20000	11000	N	22065	19462	19462
LEAD	10/10	45	5.1	N	52.78	41.09	41.09
MANGANESE	10/10	560	47	L	1298.00	600.70	560
MERCURY	7/10	0.24	0.044	X	0.32	0.25	0.24
NICKEL	10/10	**140**	5.9	X	140	140	140
SELENIUM	8/10	1.3	0.77	X	1.44	1.27	1.3
SILVER	1/10	65	65	ND	ND	ND	65
THALLIUM	2/10	3.7	1.2	ND	ND	ND	3.7
VANADIUM	10/10	28	13	N	33.47	28.70	28
ZINC	10/10	**280**	17	L	549.50	247.90	248
Background Concentration (mg/kg) for Subsurface Soil							
ALUMINUM	10/10	17000	2100	N	21429	17267	17000
ANTIMONY	0/10	2.5	2.1	ND	ND	ND	ND
ARSENIC	9/10	7.3	1.2	N	9.83	7.62	7.30
BARIUM	9/10	100	18	N	143.5	110.3	100
BERYLLIUM	5/10	1.1	0.58	X	1.327	1.12	1.10
CADMIUM	1/10	1.4	1.4	ND	ND	ND	1.4
CHROMIUM	10/10	24	3.7	N	33.33	26.91	24
COBALT	10/10	1000	3.5	X	1000	1000	1000
COPPER	10/10	20	1.2	N	27.27	21.21	20
IRON	10/10	40000	3900	N	47509	37791	37791
LEAD	10/10	**56**	2.5	L	90.65	38.45	38.45
MANGANESE	10/10	330	37	N	405.1	313.5	313.5
MERCURY	2/10	0.25	0.053	ND	ND	ND	0.25
NICKEL	10/10	16	2.9	N	22.73	18.35	16
SELENIUM	6/10	1.1	0.55	X	1.38	1.18	1.1
SILVER	0/10	1.3	1	ND	ND	ND	ND
THALLIUM	0/10	**6**	1	ND	ND	ND	ND
VANADIUM	10/10	37	4	N	53.83	43.56	37
ZINC	10/10	**67**	8.7	N	77.04	61.09	61.09
Background Concentration (mg/kg) for All Depth Soil							
ALUMINUM	20/20	19000	2100	N	18812	16341	16341
ANTIMONY	0/20	2.5	2.1				
ARSENIC	19/20	7.3	1.2	X	7	5.98	5.98
BARIUM	19/20	160	18	X	135	113.6	113.6
BERYLLIUM	9/20	1.1	0.55	X	1.13	1.01	1.01

Table 9-2
Toal Metal Results (mg/kg) for Surface, Subsurface and All Depth Soils, Background Reference Area (cont.)

Analyte	(Detected/ Total) Samples	Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
CADMIUM	3/20	1.4	0.92				1.4
CHROMIUM	20/20	24	3.7	N	26.25	23.2	23.2
COBALT	20/20	2900	3.2	X	2900	2805	2805
COPPER	20/20	48	1.2	G	36.05	-	36.05
IRON	20/20	40000	3900	G	30678	-	30678
LEAD	20/20	56	2.5	G	39.95	-	39.95
MANGANESE	20/20	560	37	G	388.2	-	388.2
MERCURY	9/20	0.25	0.044	X	0.256	0.21	0.21
NICKEL	20/20	140	2.9	X	140	134.1	134.1
SELENIUM	14/20	1.3	0.55	X	1.38	1.24	1.24
SILVER	1/20	65	65				65
THALLIUM	2/20	3.7	1.2				3.7
VANADIUM	20/20	37	4	N	41.08	35.98	35.98
ZINC	20/20	280	8.7	G	136.4	-	136.4

Notes:

BKGD = Background
Dist = Distribution
mk/kg = Milligrams per kilogram
ND = Not determined (Detected sample<5)
UTL = Upper Tolerance Limit
UPL = Upper Prediction Limit
L = Lognormal
N = Normal
X = Neither normal nor lognormal
The highlighted are outliers at 5% significance level (By using Dixon's outlier test)
For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.
For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-3
Radionuclide Results (pCi/L) for Unfiltered Groundwater, Background Reference Area

Analyte	(Detected/ Total) Samples	Detected Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
Ra-226	6/10	**0.7**	0.21	X	0.728	0.58	0.58
Ra-228	1/10	0.75	0.75	ND	ND	ND	0.75
Th-228	0/10	0.069	-0.026	ND	ND	ND	ND
Th-230	0/10	0.094	-0.029	ND	ND	ND	ND
Th-232	3/10	0.053	0.041	ND	ND	ND	0.053
U-234	9/10	0.29	0.091	N	0.39	0.315	0.29
U-235	1/10	0.082	0.082	ND	ND	ND	0.082
U-238	8/10	0.41	0.067	X	0.49	0.38	0.38

Notes:

BKGD = Background
Dist = Distribution
ND = Not determined (Detected sample<5)
pCi/L = Piccocuries per liter
UTL = Upper Tolerance Limit
UPL = Upper Prediction Limit
L = Lognormal
N = Normal
X = Neither normal nor lognormal
The highlighted are outliers at 5% significance level (By using Dixon's outlier test)
For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.
For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-4
Total Metals Results (mg/L) for Unfiltered Groundwater, Background Reference Area

Analyte	(Detected/ Total) Samples	Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
ALUMINUM	8/10	1.4	0.21	X	1.78	1.37	1.37
ANTIMONY	0/10	0.02	0.02	ND	ND	ND	ND
ARSENIC	7/10	0.065	0.017	X	0.070	0.057	0.057
BARIUM	4/10	0.16	0.1	ND	ND	ND	0.16
BERYLLIUM	0/10	0.005	0.005	ND	ND	ND	ND
CADMIUM	0/10	0.005	0.005	ND	ND	ND	ND
CHROMIUM	0/10	0.01	0.01	ND	ND	ND	ND
COBALT	6/10	**4.7**	0.037	X	4.62	3.25	3.25
COPPER	0/10	0.01	0.01	ND	ND	ND	ND
IRON	10/10	110	0.19	N	141.9	105.4	105.4
LEAD	3/10	0.021	0.004	ND	ND	ND	0.021
MANGANESE	10/10	4.8	0.71	N	6.33	5.00	4.8
MERCURY	0/10	0.0002	0.0002	ND	ND	ND	ND
NICKEL	2/10	0.049	0.043	ND	ND	ND	0.049
SELENIUM	0/10	0.005	0.005	ND	ND	ND	ND
SILVER	0/10	0.01	0.01	ND	ND	ND	ND
THALLIUM	0/10	0.01	0.01	ND	ND	ND	ND
VANADIUM	0/10	0.01	0.01	ND	ND	ND	ND
ZINC	1/10	0.023	0.023	ND	ND	ND	0.02

Notes:

BKGD = Background

Dist = Distribution

mg/L = Milligrams per liter

ND = Not determined (Detected sample<5)

UTL = Upper Tolerance Limit

UPL = Upper Prediction Limit

L = Lognormal

N = Normal

X = Neither normal nor lognormal

The highlighted are outliers at 5% significance level (By using Dixon's outlier test)

For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.

For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-5
Radionuclide Results (pCi/L) for Surface Water, Background Reference Area

Analyte	(Detected/ Total) Samples	Detected Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
Ra-226	2/10	0.34	0.19	ND	ND	ND	0.34
Ra-228	0/10	0.57	-0.09	ND	ND	ND	ND
Th-228	0/10	0.023	-0.017	ND	ND	ND	ND
Th-230	0/10	0.052	-0.046	ND	ND	ND	ND
Th-232	0/10	0.019	-0.008	ND	ND	ND	ND
U-234	10/10	**0.39**	0.087	N	0.437	0.347	0.35
U-235	1/10	0.037	0.037	ND	ND	ND	0.037
U-238	6/10	**0.42**	0.048	X	0.43	0.327	0.327

Notes:

BKGD = Background

Dist = Distribution

ND = Not determined (Detected sample<5)

pCi/L = Piccocuries per liter

UTL = Upper Tolerance Limit

UPL = Upper Prediction Limit

L = Lognormal

N = Normal

X = Neither normal nor lognormal

The highlighted are outliers at 5% significance level (By using Dixon's outlier test)

For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.

For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-6
Radionuclide Results (pCi/g) for Sediment, Background Reference Area

Analyte	(Detected/ Total) Samples	Detected Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
Ra-226	6/10	0.55	0.31	X	0.669	0.575	0.55
Ra-228	1/10	0.55	0.55	ND	ND	ND	0.55
Th-228	10/10	0.45	0.267	N	0.486	0.43	0.43
Th-230	10/10	0.46	0.256	N	0.54	0.475	0.46
Th-232	10/10	0.39	0.208	N	0.477	0.417	0.39
U-234	10/10	0.52	0.291	N	0.635	0.554	0.52
U-235	7/10	0.053	0.023	X	0.058	0.0488	0.05
U-238	10/10	**0.65**	0.272	L	0.78	0.604	0.60

Notes:

BKGD = Background
Dist = Distribution
ND = Not determined (Detected sample<5)
pCi/g = Piccocuries per gram
UTL = Upper Tolerance Limit
UPL = Upper Prediction Limit
L = Lognormal
N = Normal
X = Neither normal nor lognormal
The highlighted are outliers at 5% significance level (By using Dixon's outlier test)
For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.
For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-7
Toal Metal Results (mg/L) for Surface Water, Background Reference Area

Analyte	(Detected/ Total) Samples	Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
ALUMINUM	10/10	**5.8**	0.24	L	14.17	5.08	5.08
ANTIMONY	0/10	0.02	0.02	ND	ND	ND	ND
ARSENIC	1/10	0.025	0.025	ND	ND	ND	0.025
BARIUM	1/10	0.15	0.15	ND	ND	ND	0.15
BERYLLIUM	0/10	0.005	0.005	ND	ND	ND	ND
CADMIUM	0/10	0.005	0.005	ND	ND	ND	ND
CHROMIUM	3/10	0.059	0.011	ND	ND	ND	0.059
COBALT	2/10	0.046	0.02	ND	ND	ND	0.046
COPPER	9/10	**0.081**	0.01	L	0.160	0.080	0.080
IRON	10/10	**13**	0.39	L	40.1	12.66	12.66
LEAD	10/10	**0.54**	0.0063	L	2.445	0.56	0.54
MANGANESE	10/10	**0.29**	0.033	L	0.479	0.24	0.24
MERCURY	1/10	0.0015	0.0015	ND	ND	ND	0.0015
NICKEL	1/10	0.046	0.046	ND	ND	ND	0.046
SELENIUM	0/10	0.005	0.005	ND	ND	ND	ND
SILVER	0/10	0.01	0.01	ND	ND	ND	ND
THALLIUM	0/10	0.01	0.01	ND	ND	ND	ND
VANADIUM	5/10	**0.052**	0.012	X	0.05	0.04	0.04
ZINC	10/10	**1.3**	0.079	L	2.65	1.16	1.16

Notes:

BKGD = Background

Dist = Distribution

mg/L = Milligrams per liter

ND = Not determined (Detected sample<5)

UTL = Upper Tolerance Limit

UPL = Upper Prediction Limit

L = Lognormal

N = Normal

X = Neither normal nor lognormal

The highlighted are outliers at 5% significance level (By using Dixon's outlier test)

For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.

For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-8
Toal Metal Results (mg/kg) for Sediment, Background Reference Area

Analyte	(Detected/ Total) Samples	Concentration		Dist	95% UTL	95% UPL	Site-specific BKGD
		Maximum	Minimum				
ALUMINUM	10/10	5700	2700	N	6843	5946	5700
ANTIMONY	1/10	2.1	2.1	ND	ND	ND	2.1
ARSENIC	10/10	13	2	N	19.7	15.52	13
BARIUM	10/10	390	46	L	928.2	461.2	390
BERYLLIUM	0/10	0.59	0.51	ND	ND	ND	ND
CADMIUM	8/10	1.6	0.55	X	2.14	1.73	1.6
CHROMIUM	10/10	130	19	L	258	137.5	130
COBALT	10/10	31	5.2	N	36.03	28.42	28.42
COPPER	10/10	54	10	N	69.73	55.12	54
IRON	10/10	23000	14000	N	27038	23664	23000
LEAD	10/10	420	44	N	586	463.9	420
MANGANESE	10/10	190	90	N	239.8	204.5	190
MERCURY	10/10	0.75	0.054	N	1.037	0.796	0.75
NICKEL	10/10	30	9	N	36.51	30.23	30
SELENIUM	9/10	1.4	0.59	N	1.86	1.54	1.4
SILVER	4/10	2.7	1.6	ND	ND	ND	2.7
THALLIUM	0/10	2	1	ND	ND	ND	ND
VANADIUM	10/10	39	17	N	44.82	37.99	37.99
ZINC	10/10	930	100	N	11.43	888.4	888.4

Notes:

BKGD = Background

Dist = Distribution

mg/kg = Milligrams per kilogram

ND = Not determined (Detected sample<5)

UTL = Upper Tolerance Limit

UPL = Upper Prediction Limit

L = Lognormal

N = Normal

X = Neither normal nor lognormal

The highlighted are outliers at 5% significance level (By using Dixon's outlier test)

For detected Samples>5, Site-specific BKGD is equal to the minimum of 95% UTL, 95% UPL and the maximum detected concentration.

For detected samples<5, site-specific BKGD is equal to the maximum detected concentration.

Table 9-9
Background Concentrations by Media, Background Reference Area

Analyte	Medium-Specific Background Concentration					
	Surface Soil	Subsurface Soil	All Depth Soil	Sediment	Groundwater	Surface Water
Radionuclides						
Unit	**pCi/g**				**pCi/L**	
Ra-226	1.61	1.88	1.79	0.55	0.58	0.34
Ra-228	0.98	1.51	1.35	0.55	0.75	ND
Th-228	0.99	1.47	1.46	0.43	ND	ND
Th-230	1.18	1.33	1.28	0.46	ND	ND
Th-232	1	1.39	1.39	0.39	0.05	ND
U-234	1.65	1.42	1.5	0.52	0.29	0.35
U-235	0.09	0.1	0.09	0.05	0.08	0.04
U-238	1.55	1.34	1.44	0.6	0.38	0.33
Metals						
Unit	**mg/kg**				**mg/L**	
Aluminum	18,049	17,000	16,341	5,700	1.37	5.08
Antimony	ND	ND	ND	2.1	ND	ND
Arsenic	4.95	7.3	5.98	13	0.06	0.03
Barium	140	100	113.6	390	0.16	0.15
Beryllium	0.925	1.1	1.01	ND	ND	ND
Cadmium	1.4	1.4	1.4	1.6	ND	ND
Chromium	19	24	23.2	130	ND	0.06
Cobalt	2,900	1,000	2805	28.42	3.25	0.05
Copper	48	20	36.05	54	ND	0.08
Iron	19,462	37,791	30678	23,000	110	12.66
Lead	41.09	38.45	39.95	420	0.02	0.54
Manganese	560	313.5	388.2	190	4.8	0.24
Mercury	0.24	0.25	0.21	0.75	ND	0.002
Nickel	140	16	134.1	30	0.05	0.05
Selenium	1.27	1.1	1.24	1.4	ND	ND
Silver	65	ND	65	2.7	ND	ND
Thallium	3.7	ND	3.7	ND	ND	ND
Vanadium	28	37	35.98	37.99	ND	0.04
Zinc	247.9	61.09	136.4	888.4	0.02	1.16

Notes:

mg/kg = Milligrams per kilogram

mg/L = Milligrams per Liter

ND = Not Determined

pCi/g = Picocuries per gram

pCi/L = Picocuries per liter

FIGURES

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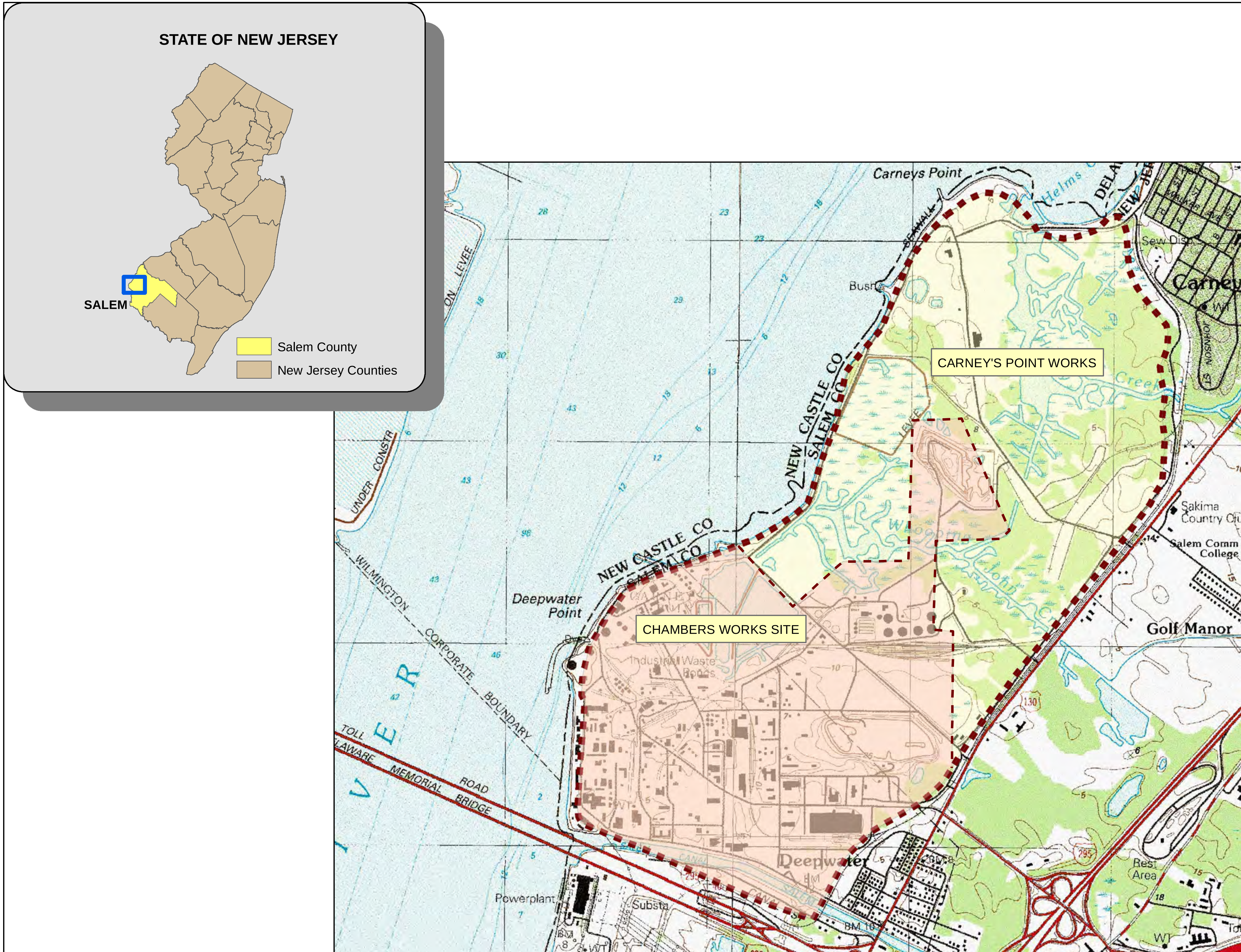

Legend	
(white box)	Carney's Point Works
(pink box)	Chambers Works Site
(dashed outline)	Site Boundary

0 850 1,700 3,400 Feet

Note:
Source: USGS 7.5" Series Quads., Wilmington South & Penns Grove, NJ, DEL 1967, photorevised respectively 1987 & 1988

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Location of DuPont Chambers Works

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 1 - 1

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OU3 AOC 4
(Historical Lagoon A)

OU2 AOC 3
(Central Drainage Ditch)

OU1 AOC 2
(F Corral, Former Building 708)

OU3

OU1 AOC 1
(Former Building 845)

OU3 AOC 6
(East Area)

Background Reference Area

OU2 AOC 5
(Building J-26 Area)

OU1

- AOC 1
- AOC 2

OU2

- AOC 3
- AOC 5

OU3

- AOC 4
- AOC 6
- Background Reference Area

0 380 760 1,520 Feet

Note: Aerial Photo taken in September 2005

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FUSRAP Operable Unit (OU) and Area of Concern (AOC) Designations

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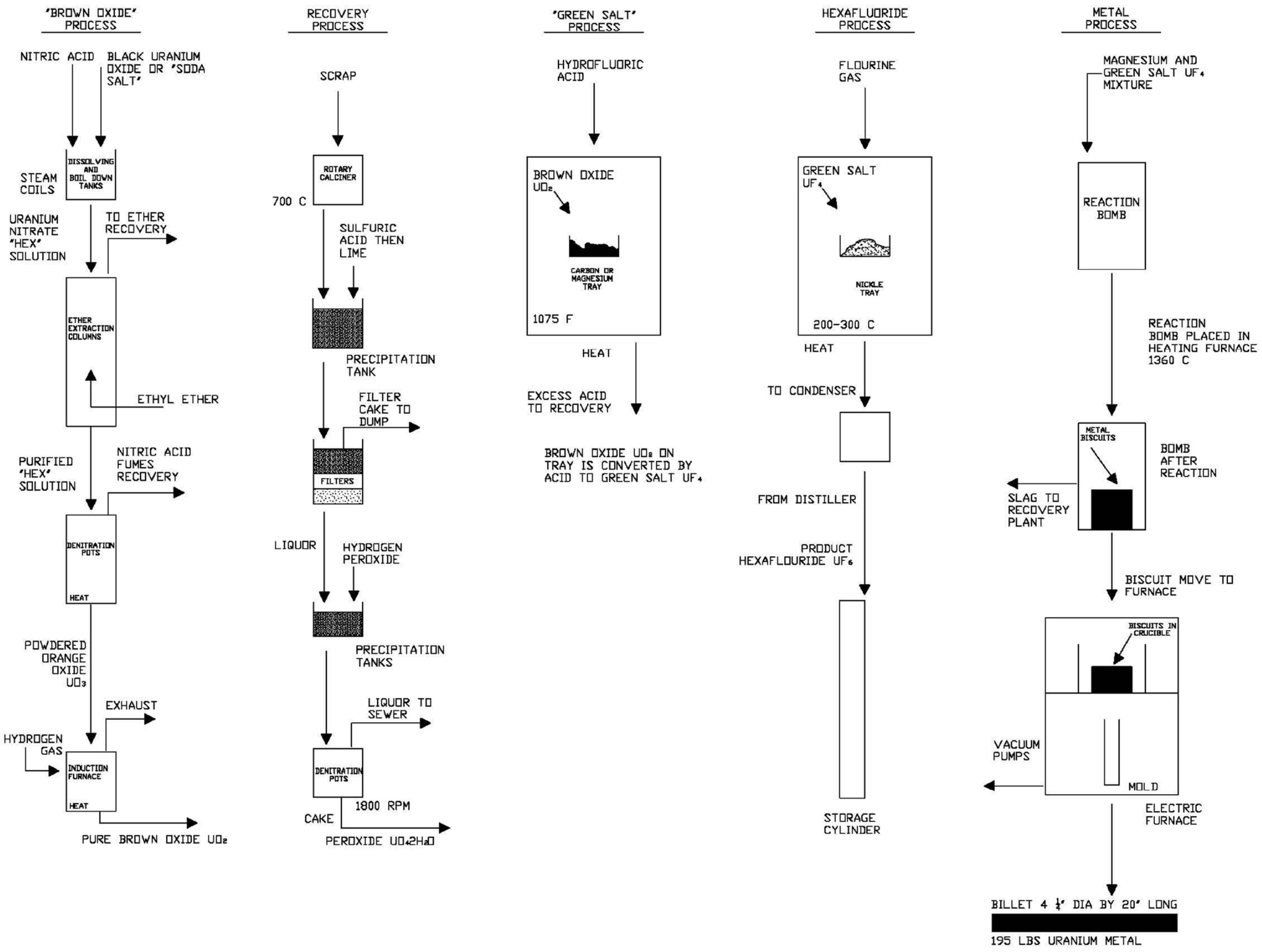

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Process Flow Diagram for Uranium Refinement and Flurocarbon Production

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Historic CDD

Present CDD

Dissolved Uranium Area

Former Building 708

Former Extent of Basin

Wooden Trough

102

101

Loading Dock (Uranium Oxide Area)

Elevator Shaft

Former Building 845 (including 101 & 102)

AOC Location

- AOC 1
- AOC 2
- Present Culvert
- Historic CDD
- Buildings 845 and 708
- Present CDD
- Historic Lagoon Area

0 60 120 240 Feet

Note: Aerial Photo taken in September 2005

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Locations of Historical Buildings and Central Drainage Ditch

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Figure 1 - 4

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Kinetic Road

Central Drainage Ditch

Wooden Trough

845

Loading Dock

Stores Road

Central Drainage Ditch

Railroads

AOC 1 Boundary

Roads

0 25 50 100 Feet

N

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AOC 1 - Former Building 845 Area

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Figure 1 - 5

TS 50

706

031003

681

682

683

684

GLYCERINE ST.

Ditch since 1959

708

Concrete Slab

Ditch

Approximate location of building removed from 1954 and 1959

"F" Parking Corral

Buildings removed between 1964 and 1974

845

661

22

Central Drainage Ditch

Railroads

AOC 2 Boundary

Roads

N

0 37.5 75 150 Feet

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AOC 2 - F Parking Corral

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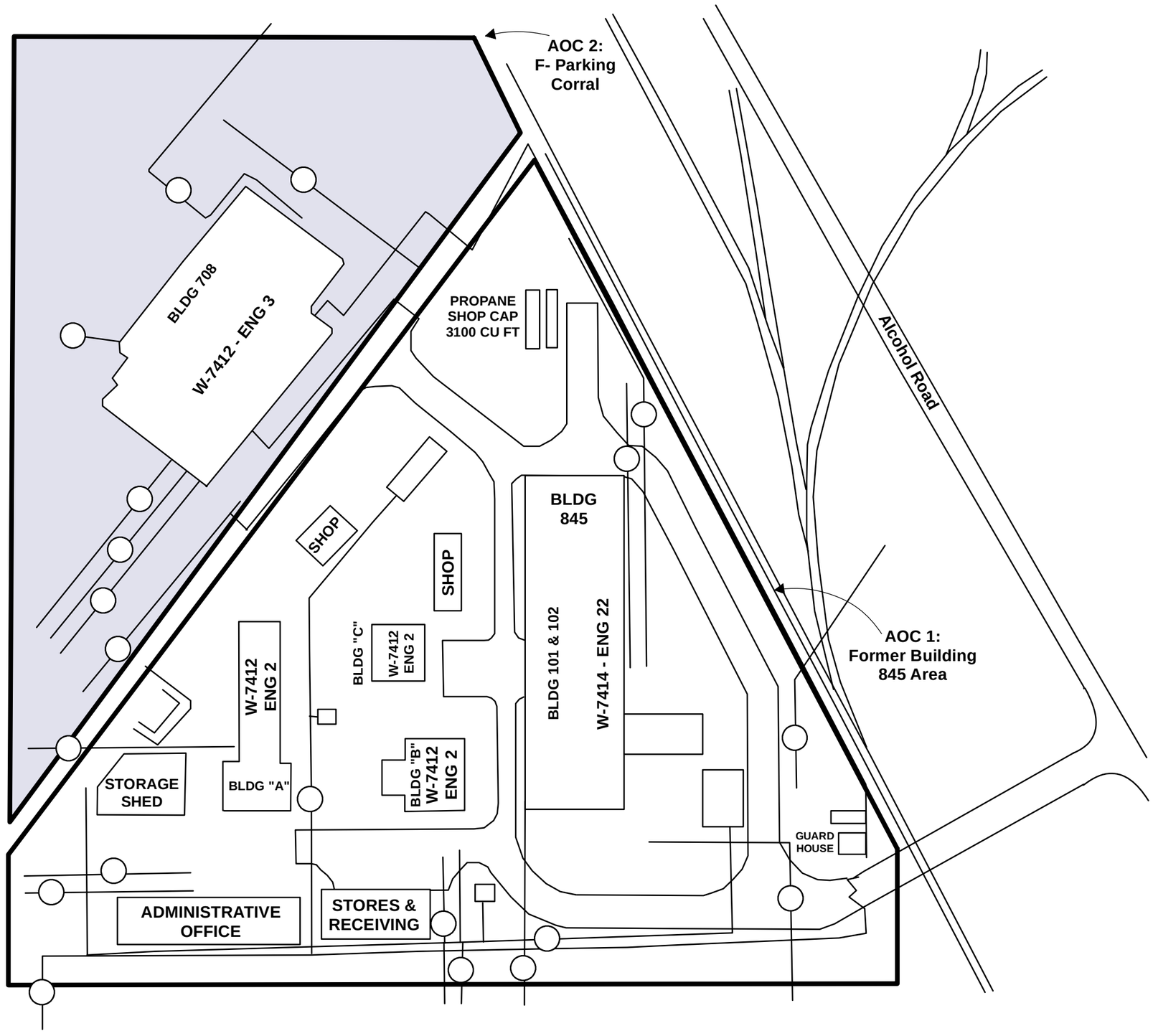

N

Government - Contracts

W-7412	-	Eng 2
W-7412	-	Eng 3
W-7412	-	Eng 22

0 35 70 140 Feet

Notes:
1. Former Building 845 contained former Buildings 101 and 102
2. AOC 2 is shown in gray

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Completion Report Utility Map from Bechtel Technical Memorandum

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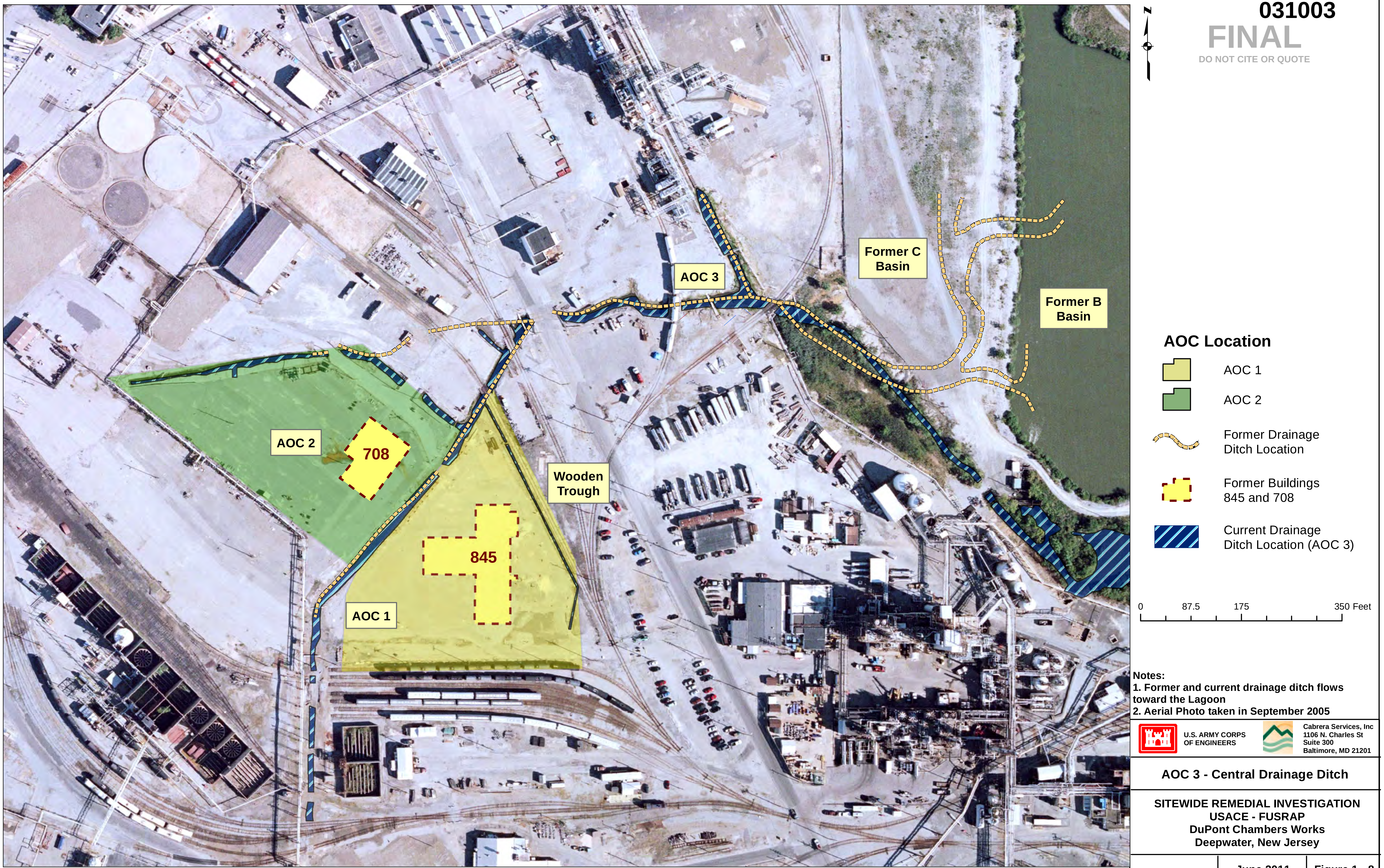

Notes:
1. Former and current drainage ditch flows toward the Lagoon
2. Aerial Photo taken in September 2005

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AOC 3 - Central Drainage Ditch

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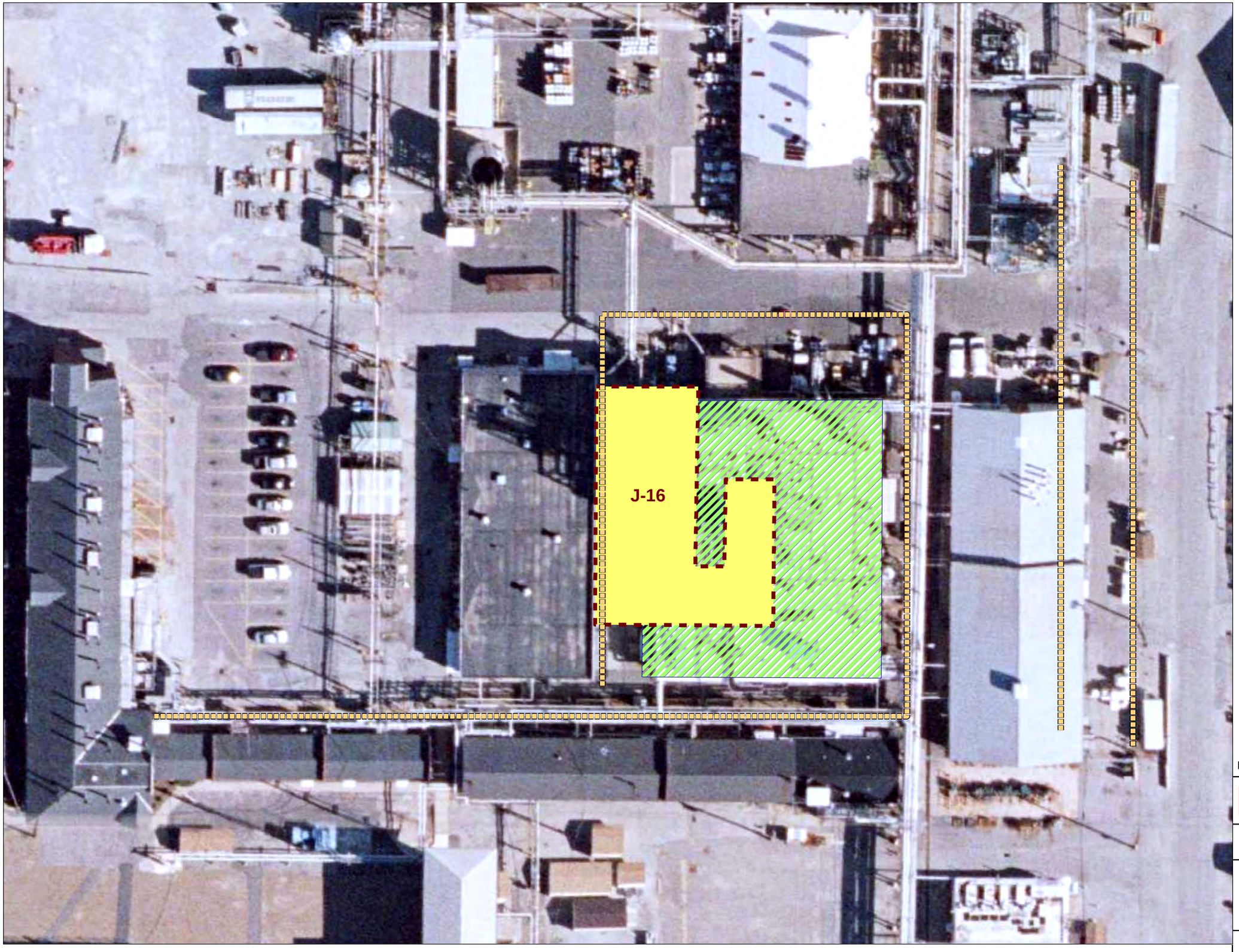

N

Drainageways

Former Location of Building J-16

Current Location of Building J-26

0 20 40 80 Feet

Note: Aerial Photo taken in September 2005

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AOC 5 Building J-26 Area

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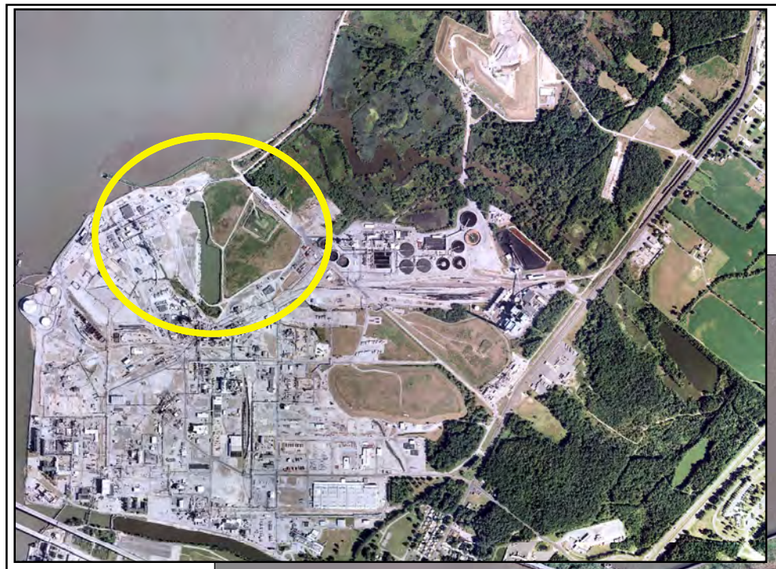

N

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Former Lagoon Area

Areas of Interest (AOIs) 1 & 2

AOC 4 Boundary

AOCs 1, 2 & 3 Boundary

0 1,150 2,300 4,600 Feet

Note: Aerial Photo taken in September 2005

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Areas of Interest
AOC 4 - Historical Lagoon

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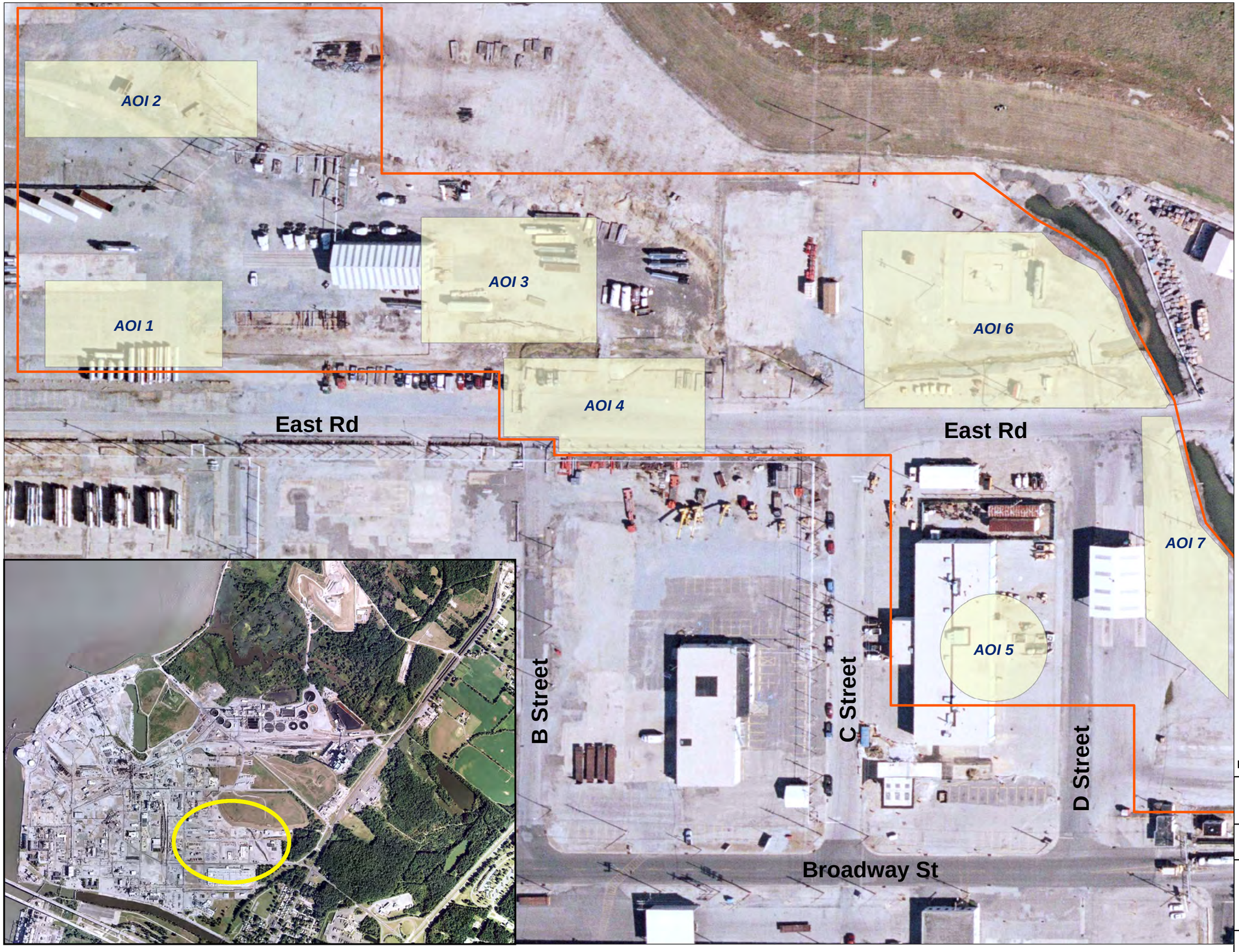

AOC 6 Boundary

Areas of Interest (AOIs)

0 60 120 240 Feet

Note: Aerial Photo taken in September 2005

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Areas of Interest
AOC 6 - East Area

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East Burial Approximate Extent of Area

Note:

During the review of historic aerial photographs, table including the grid location, feature abbreviation, location within the grid rectangle, and description of the change were produced for each AOC to track any changes between photographs of different ages.

Abbreviations were used during the aerial photographic review:

- AG – above ground/overhead infrastructure
- B – building or structure
- D – surface water drainage
- DS – debris or unidentifiable objects
- F – fill area
- G – area has been graded or leveled
- GS – ground scar or ground disturbance
- H – helicopter pad
- P – parking area
- PL – plume (sediment or effluent)
- R – road
- RR – railroad
- S – possible storage or staging area, possible containers or trailers present
- STR – structure (not building)
- SW – sidewalk
- T – tank
- TR – trail
- WT – wetlands, may have standing water
- X – no longer present (visible in prior photograph)

0 25 50 100 Feet

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MED Operations in 1944
AOC 6 (East Area)

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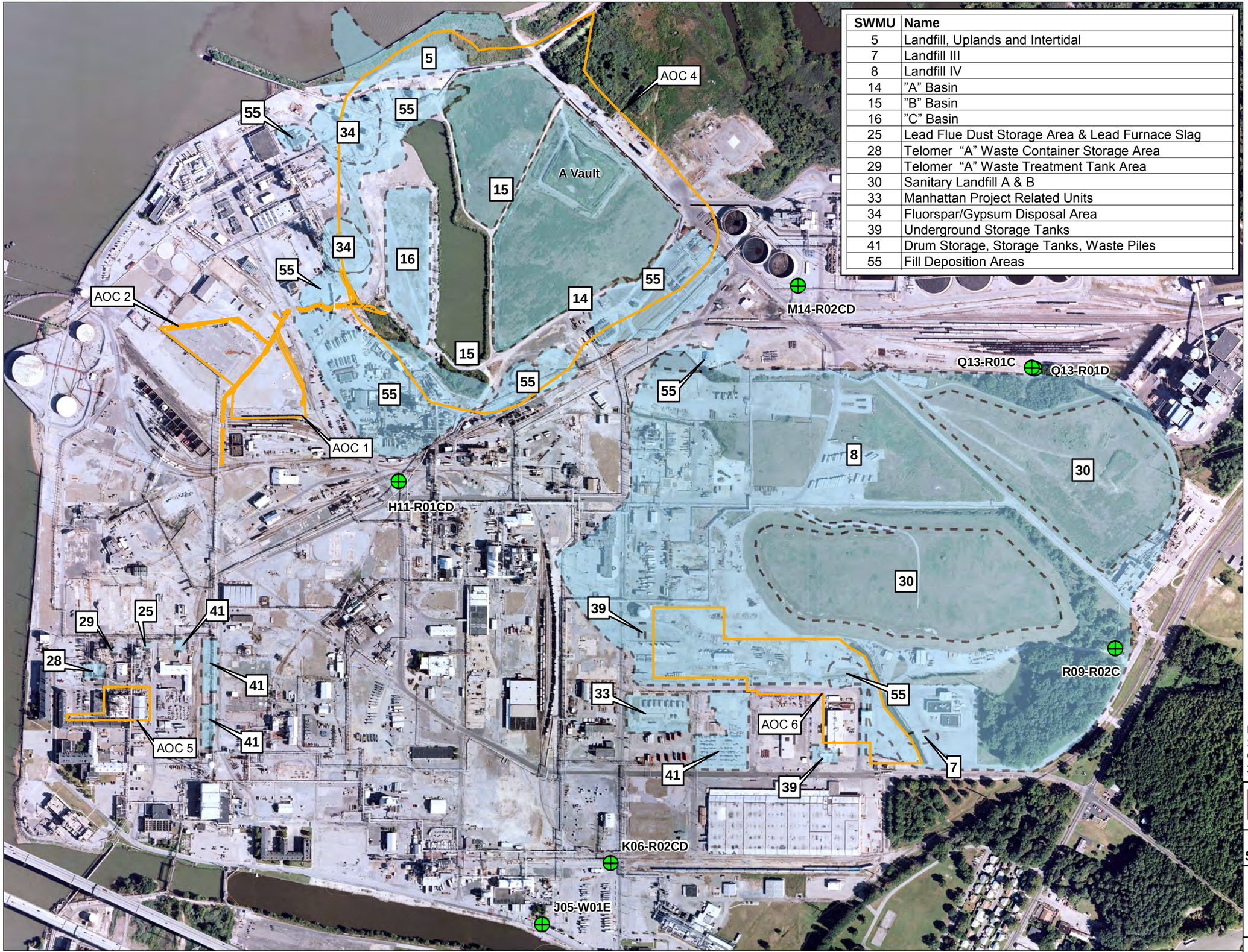
SWMU	Name
5	Landfill, Uplands and Intertidal
7	Landfill III
8	Landfill IV
14	”A” Basin
15	”B” Basin
16	”C” Basin
25	Lead Flue Dust Storage Area & Lead Furnace Slag
28	Telomer “A” Waste Container Storage Area
29	Telomer “A” Waste Treatment Tank Area
30	Sanitary Landfill A & B
33	Manhattan Project Related Units
34	Fluorspar/Gypsum Disposal Area
39	Underground Storage Tanks
41	Drum Storage, Storage Tanks, Waste Piles
55	Fill Deposition Areas



Interceptor Well System (IWS) Well Locations

55 SWMU Unit Number

Approximate SWMU Locations in proximity to FUSRAP AOCs

FUSRAP AOC Boundaries

0 287.5 575 1,150 Feet

Notes:
1. Source: Dupont Corporate Remediation Group, Drawing DWMI961001 rev 200 4/10/01
2. Aerial Photo taken in September 2005

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Approximate Location of Select DuPont Solid Waste Management Units (SWMUs)

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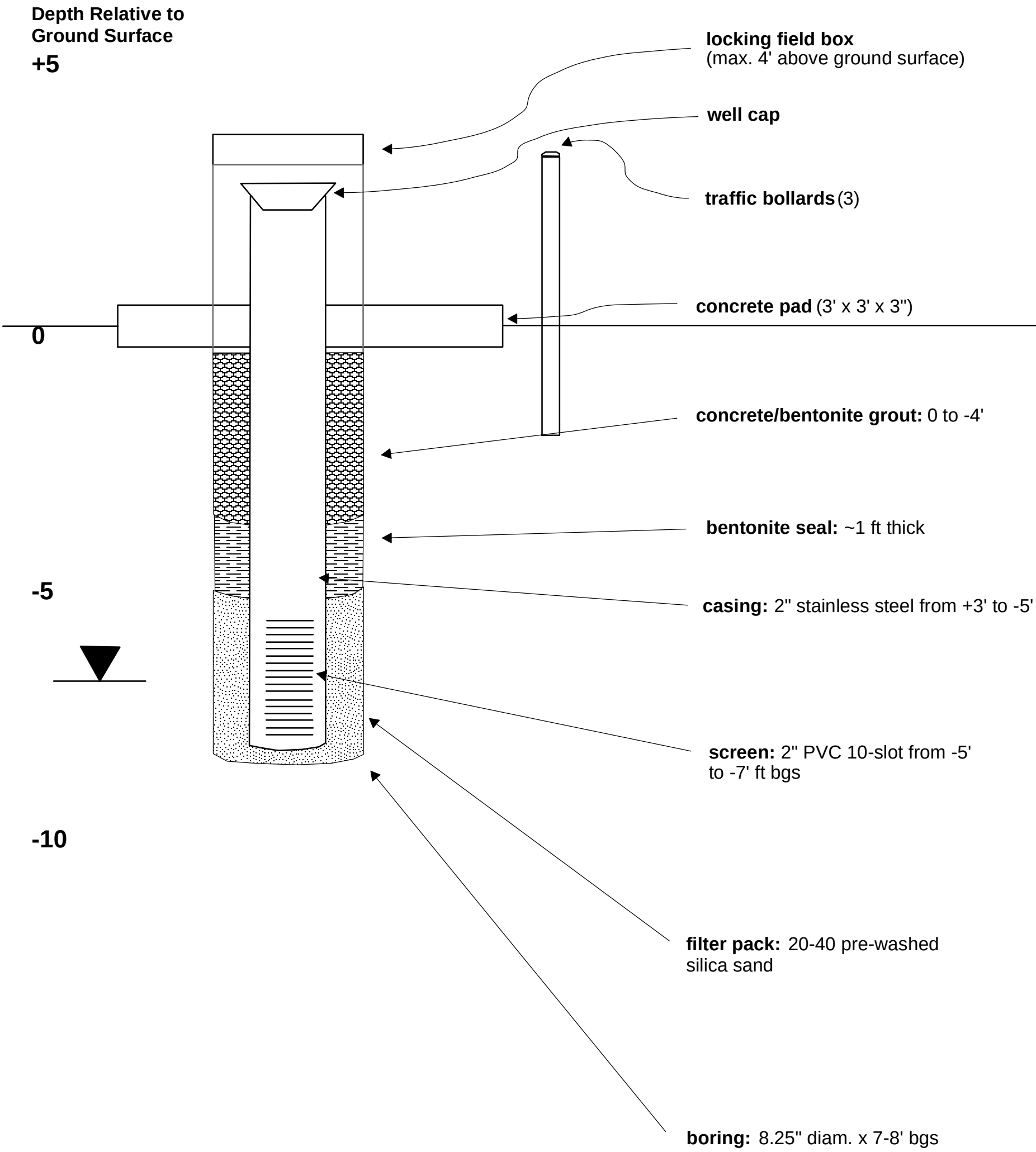

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Well Design "A" Aquifer Wells

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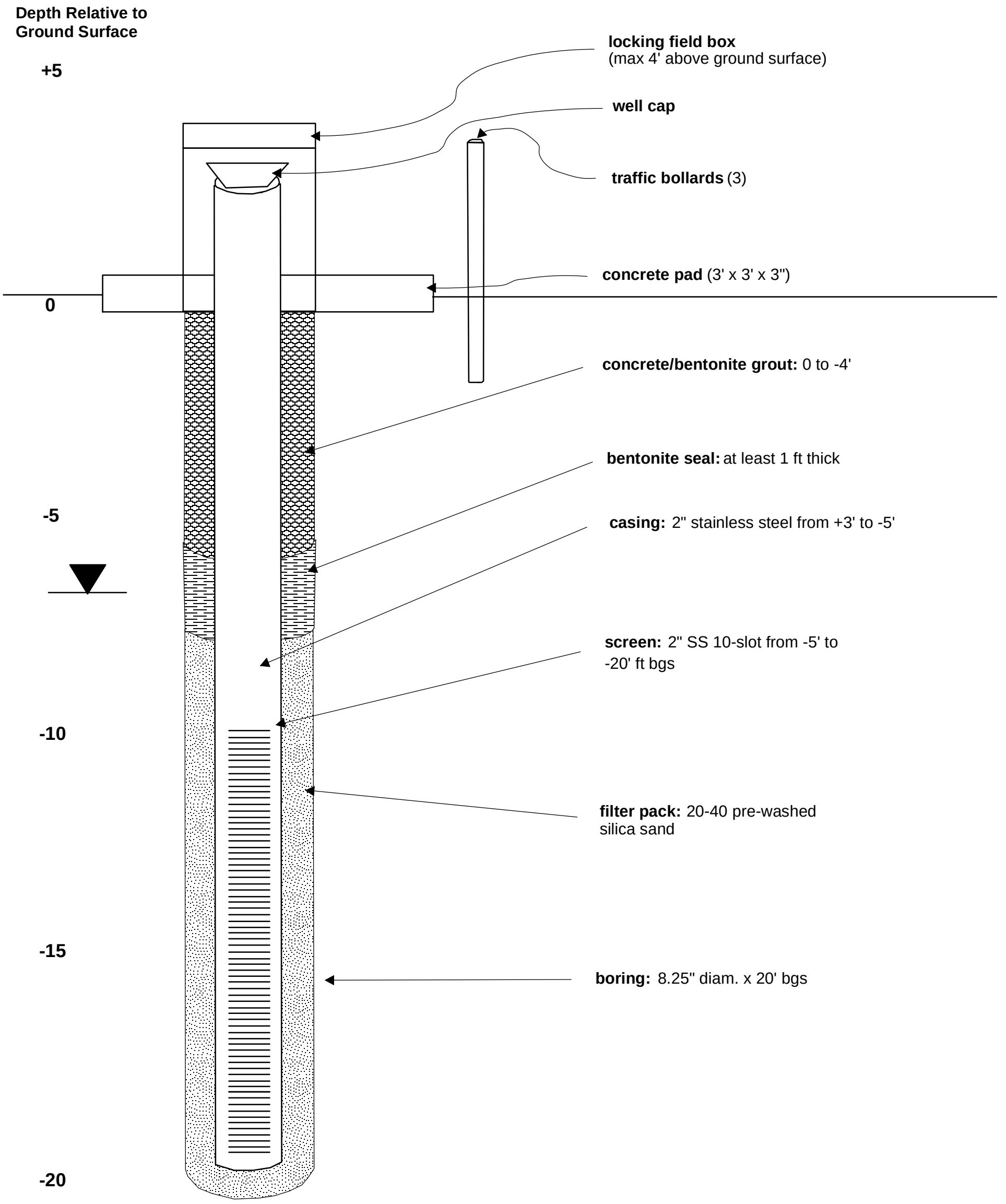

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Well Design "B" Aquifer Wells

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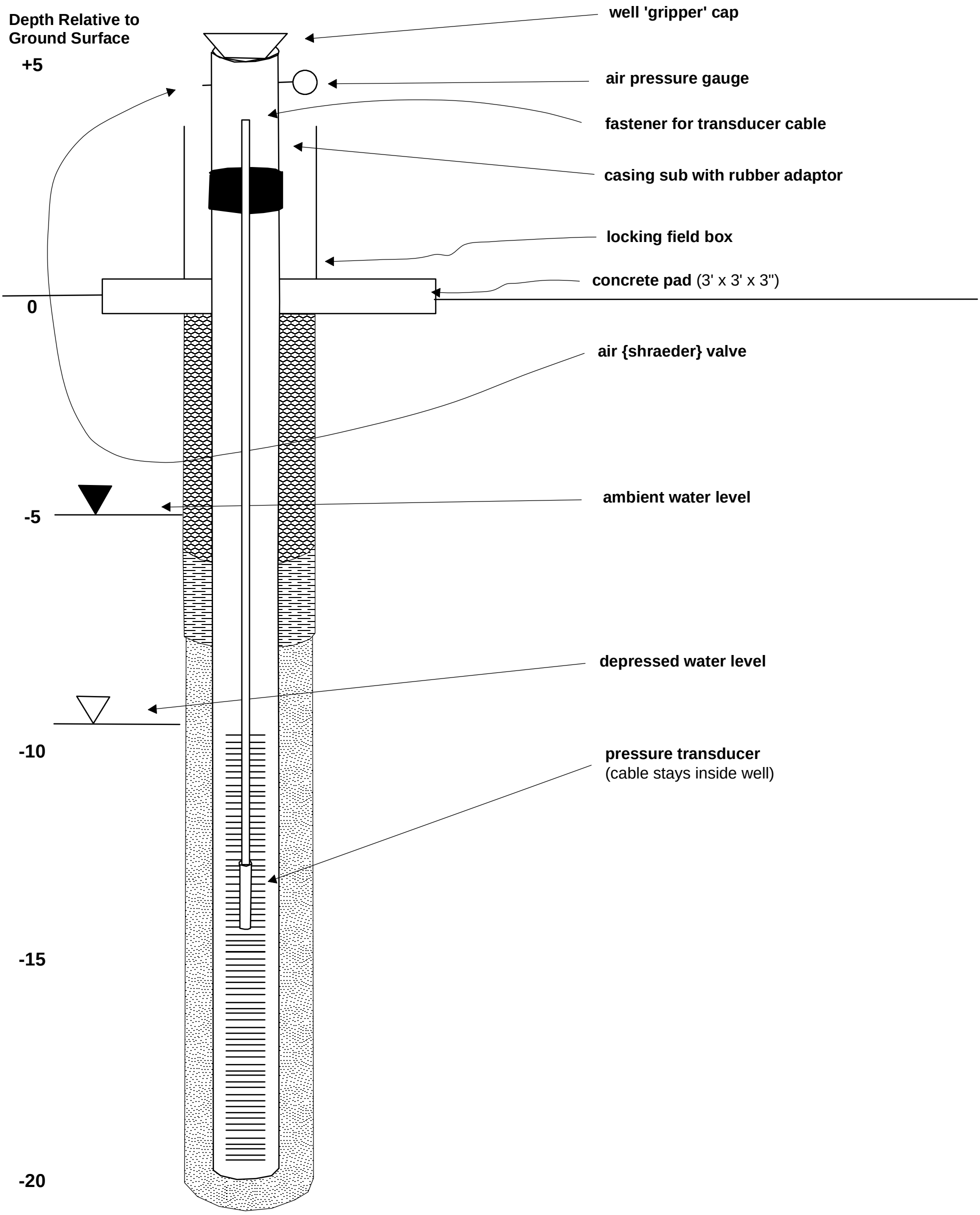

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Pneumatic Slug Test Equipment

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Site Outline

Land Use

- Barren Land
- Forest
- Urban
- Water
- Wetland

0 295 590 1,180 Feet

Notes:
1. Source: New Jersey Department of Environmental Protection
2. Aerial Photo taken in September 2005

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Land Use Areas

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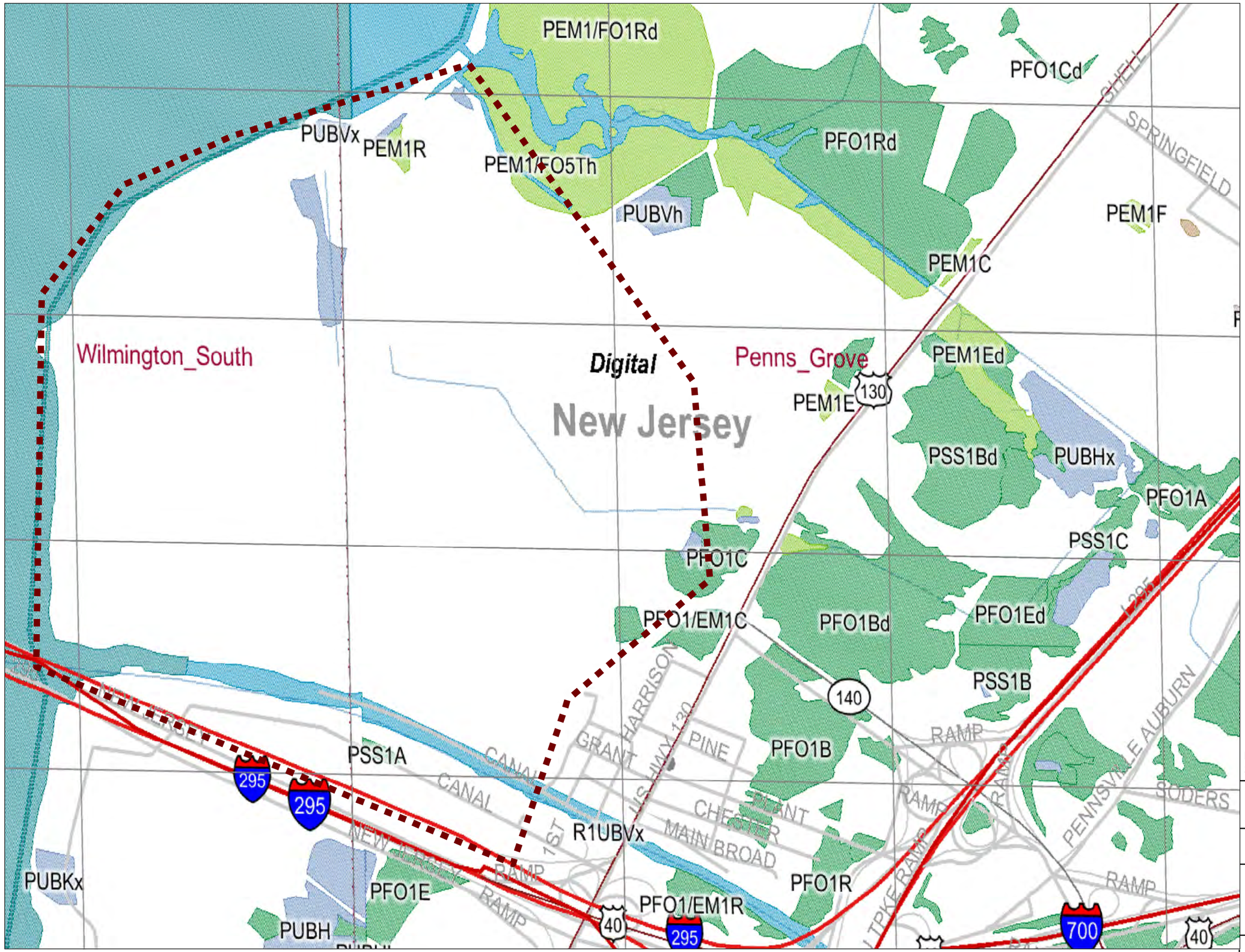

Site Outline

Interstate

Major Roads

Roads

NHD Streams

Estuarine and Marine Deepwater

Estuarine and Marine Wetland

Freshwater Emergent Wetland

Freshwater Forested/Shrub Wetland

Freshwater Pond

Lake

Other

Riverine

0 450 900 1,800 Feet

Notes:

1. Source: US Fish and Wildlife

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Wetland Delineation Areas

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Lafayette-Perish Elementary School

St. James High School

Salem Community College

Memorial Hospital of Salem County

Park Bible School

Central Park Elementary School

Pennsville Memorial High School

Pennsville Middle School

Penn Beach Elementary School

Chambers Works Exit

School

Hospital

1 Mile Radius from Exit

0 1,500 3,000 6,000 Feet

Source: USGS 7.5" Series Quads., Wilmington South & Penns Grove, NJ, DEL 1967, photo revised respectively 1987 & 1988

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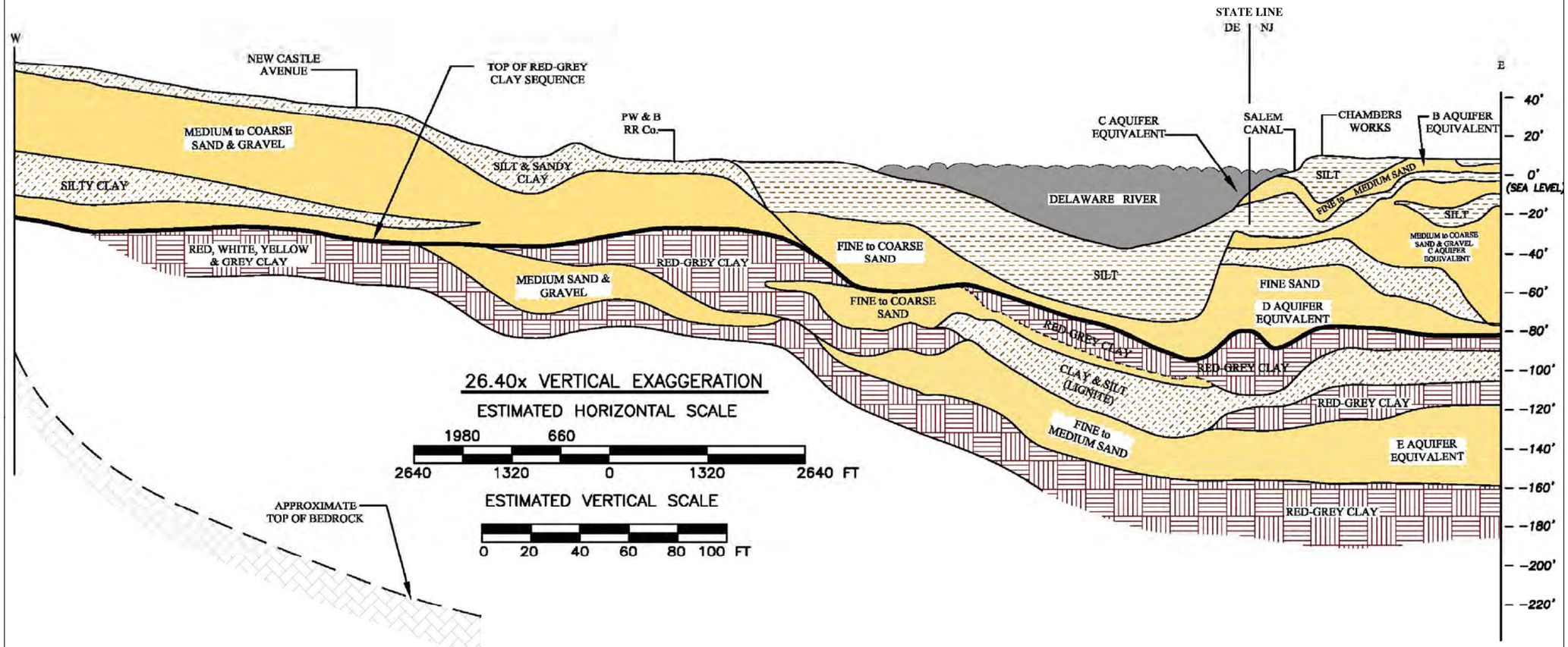
Schools and Hospitals Location of Area

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 3 - 3**



LEGEND

- SILT AND CLAY
- SILT
- FINE TO COARSE AND FINE SAND
- FINE TO MEDIUM SAND
- MEDIUM TO COARSE SAND AND GRAVEL
- RED–GREY CLAY
- BEDROCK

NOTE:
CHAMBERS WORKS USES TOP OF RED-GREY CLAY AS A MARKER BED FOR THE TOP OF THE CRETACEOUS POTOMAC CLAY. MARINE & RASMUSSEN (1995) INDICATE THAT THE CONTACT BETWEEN THE PLEISTOCENE AND CRETACEOUS MAY BE HIGHER IN THE SEQUENCE WITHIN THE D AQUIFER SAND.

Source: Phase IV RCRA Facility Investigation Report Dupont Chambers Works, Project No. 507447, 18983781.00002, Corporate Remediation Group, April 2005

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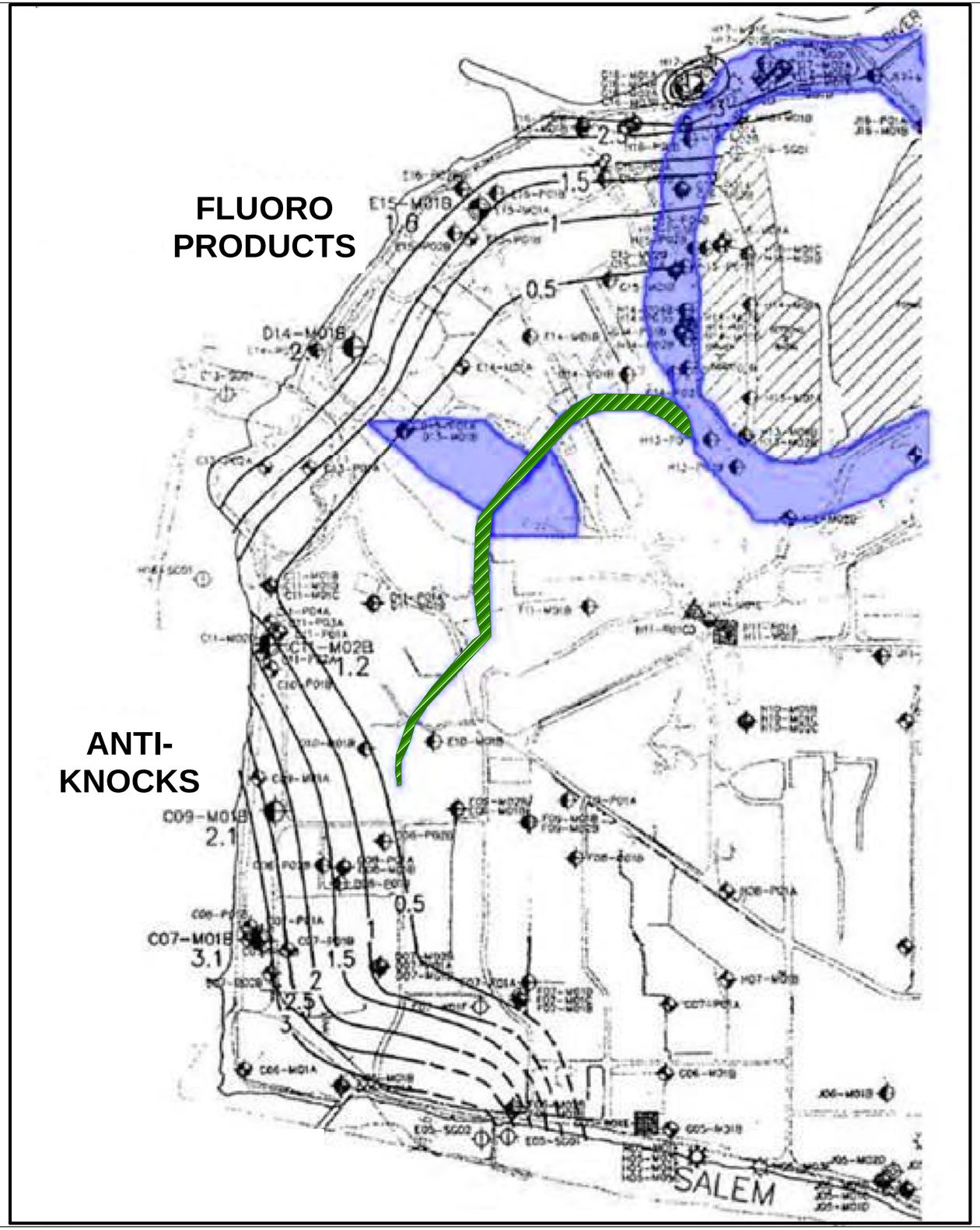
Geologic Profile beneath DuPont Chambers Works

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 3 - 4



AOC3

AOCs 1, 2, and 4

0.5 Effect of Tidal Influence in B Aquifer (ft)

0 275 550 1,100 Feet

Source: ENVIRON International Corporation, 1999, Groundwater Discharge within a Tidal Influenced Aquifer at Dupont Chambers Works, Deepwater NJ, Dames

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Tidal Influence in the "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 3 - 5

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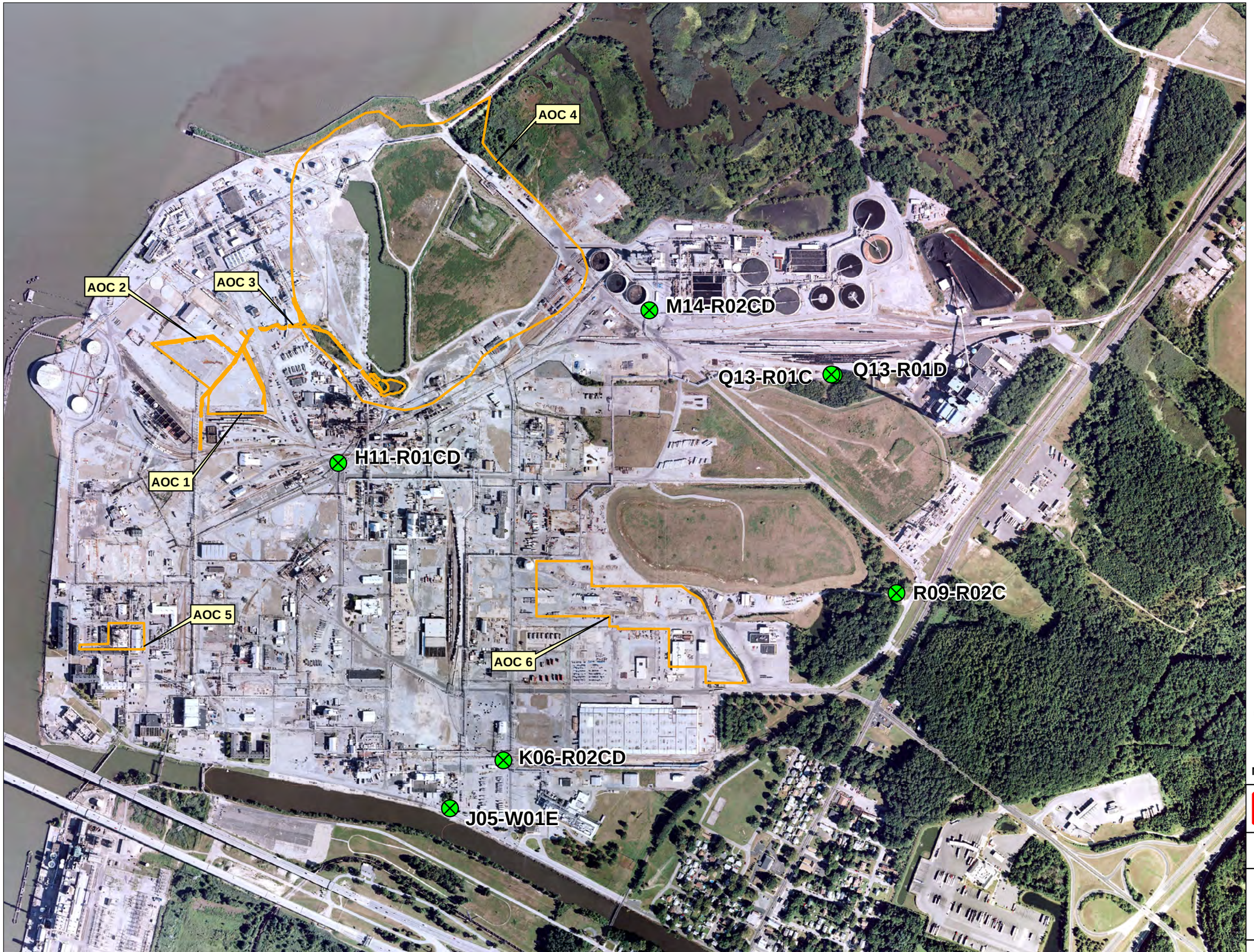

Well Locations

AOC Boundaries

0 395 790 1,580 Feet

Note: Aerial Photo taken in September 2005

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Interceptor Well Locations

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GLYCERINE STREET

FORMER BUILDING 708

FORMER BUILDING 845

STORES ROAD

N

4 Topographic Elevation Contour
Contour Interval 0.5 Foot

0 25 50 100 Feet

Note: Aerial Photo taken in September 2005

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Topographic Survey AOC 1 - Building 845 and AOC 2 - F Parking Corral

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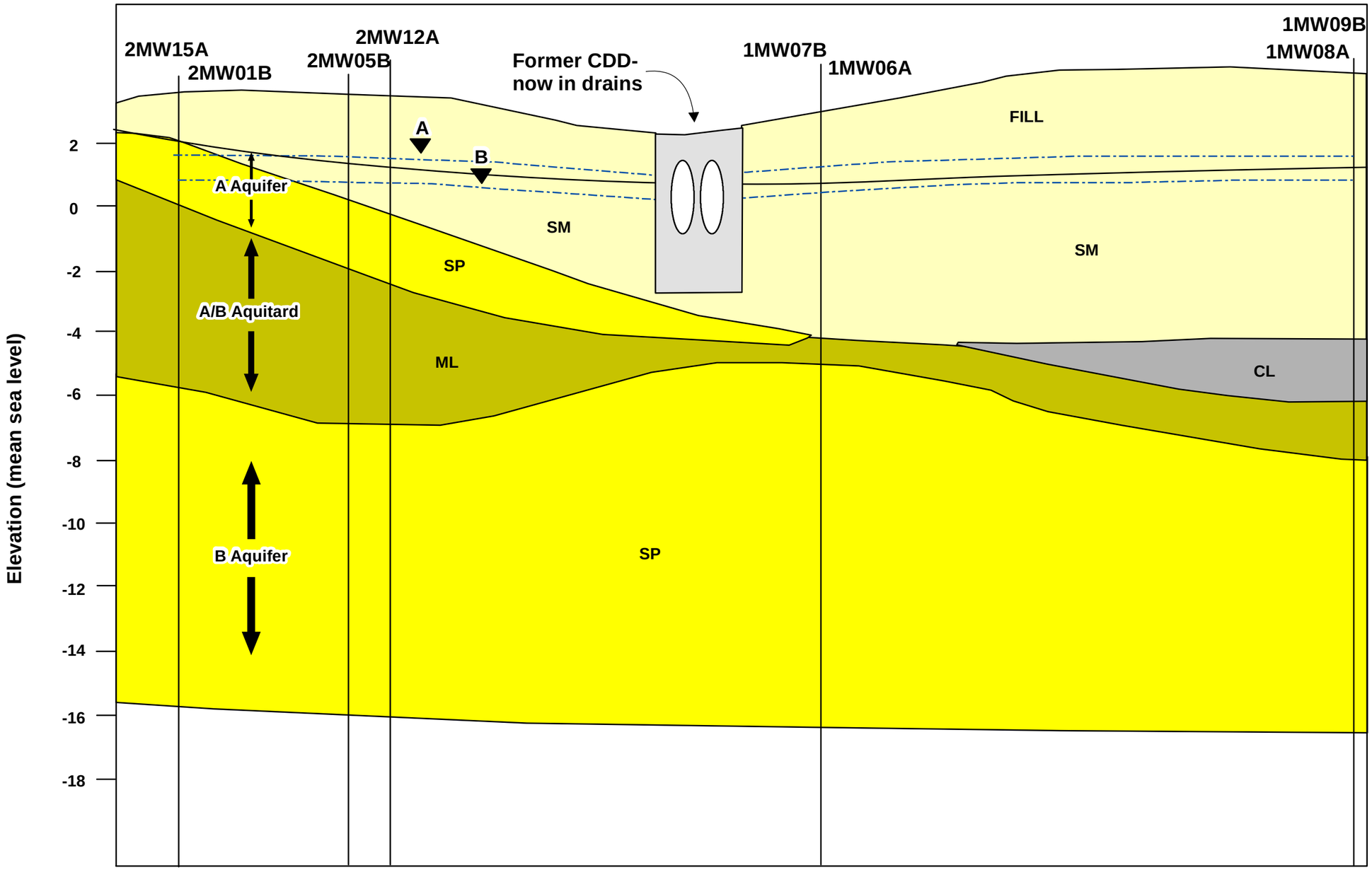
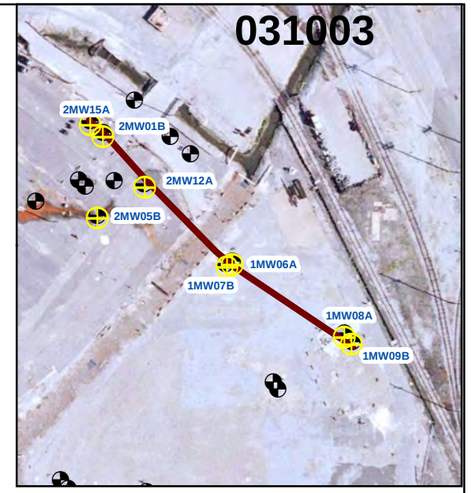
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 1





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CL (Clays)

SP (Poorly Graded Sands)

ML (Well-Graded Sands)

SM (Sand, Silty)

Note: Aerial Photo taken in September 2005

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Geologic Cross Section
AOC 1 and AOC 2

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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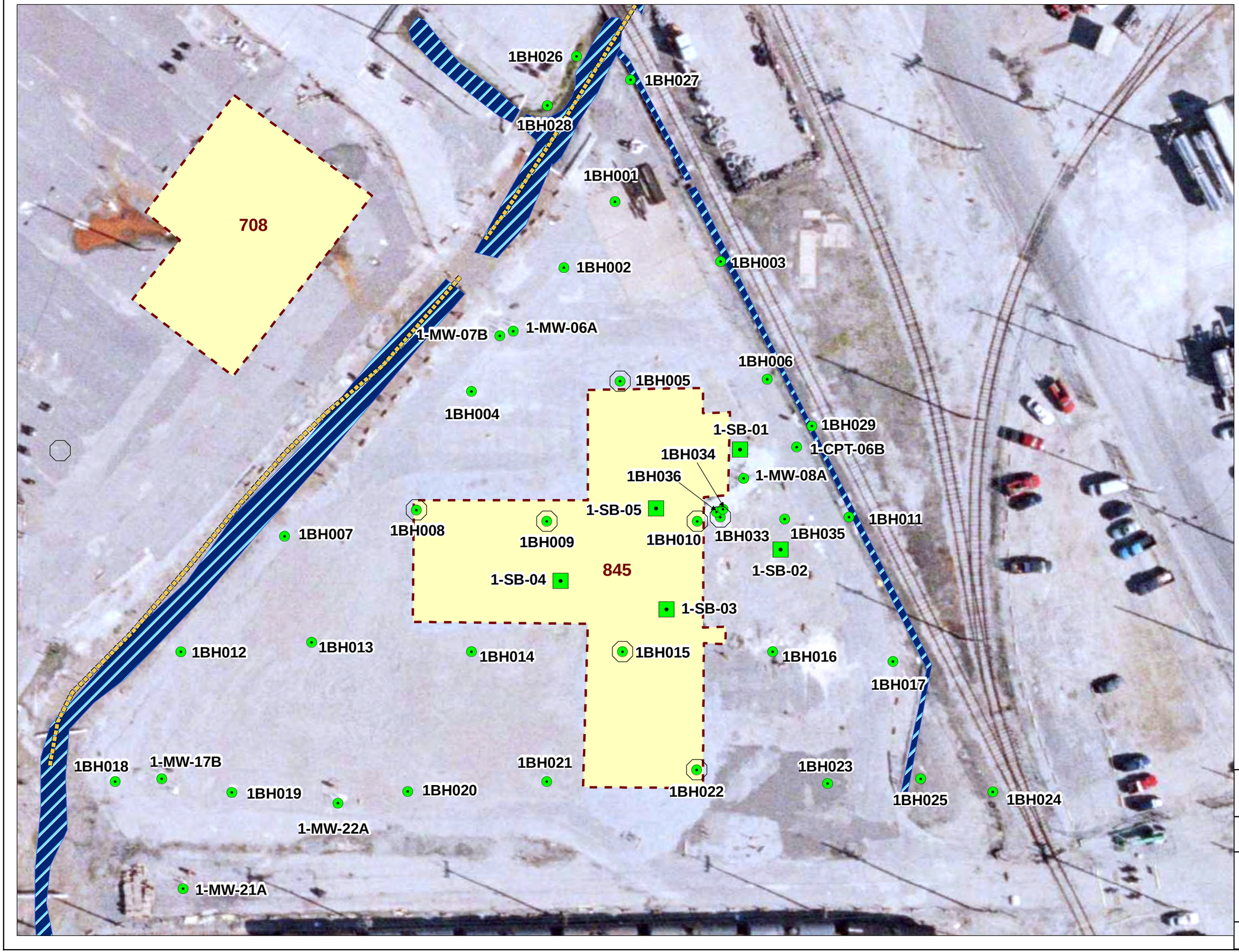

Soil Sample Locations with Concrete Cores Collected

Additional 2007 Soil Sample Locations

Soil Sample Locations

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 25 50 100 Feet

Note: Aerial Photo taken in September 2005

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AOC 1 Soil Sampling Locations

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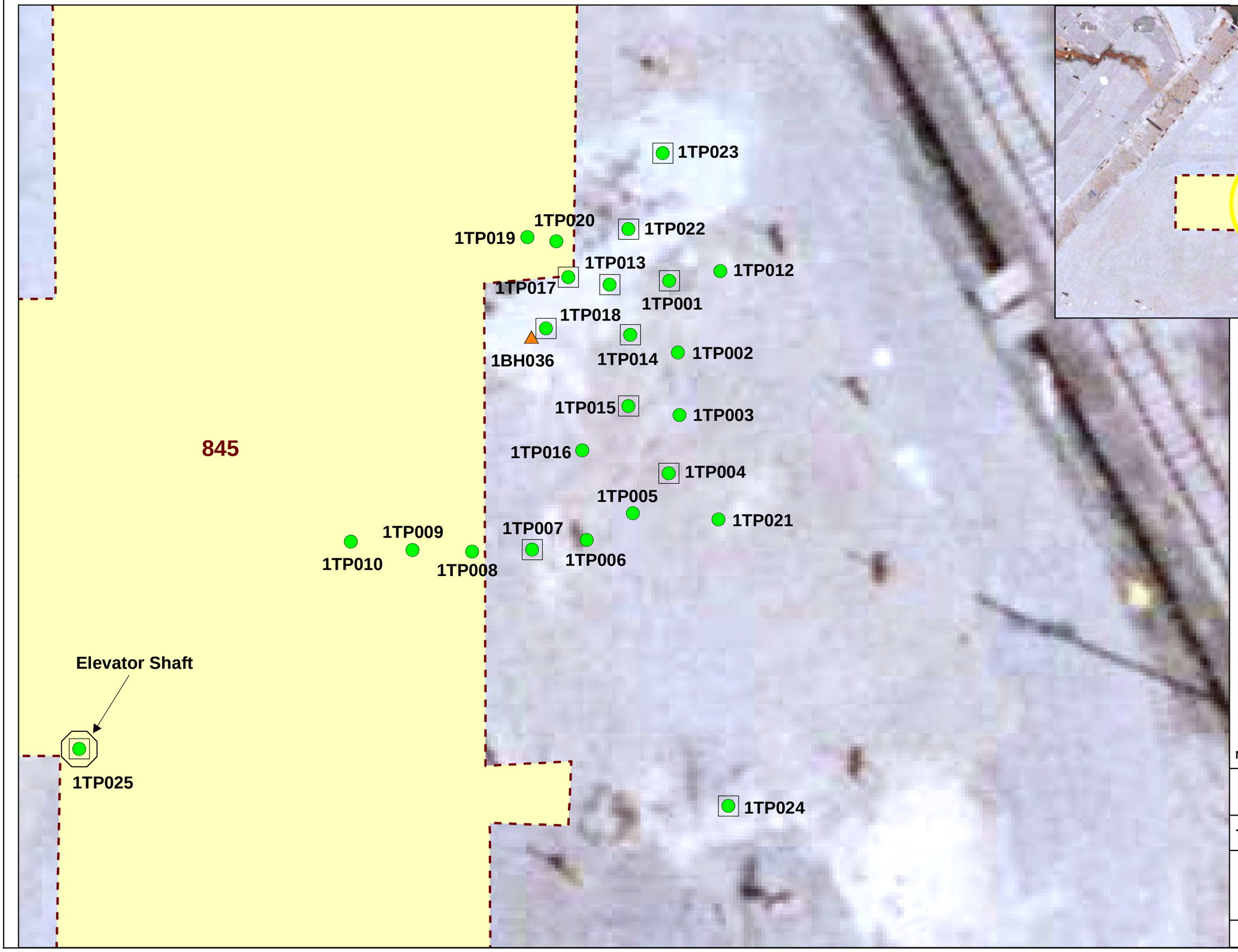
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersy

June 2011 | Figure 4 - 3



Note: Aerial Photo taken in September 2005

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Test Pit Locations - Uranium Oxide Area

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 4 - 4

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N

2BH001
2BH002
2BH003
2BH004
2-MW-19A
2BH009
2-MW-15A
2BH011
2BH005
2BH006
2BH007
2BH008
2BH010
2-MW-01B
2-MW-23B
2-MW-02A
2-SB-06
2BH020
2BH013
2BH018
2-SB-10
2-MW-25C
2-MW-20A
2BH012
2BH014
2-SB-09
2BH042
2-MW-16B
2BH015
2BH016
2BH017
2BH019
2-MW-03B
2-SB-07
2-MW-04B
2BH038
2-MW-12A
2-MW-05B
2BH027
708
2BH021
2BH022
2BH023
2BH024
2BH025
2BH026
2-SB-08
2-MW-26A
2BH031
2BH043
2BH033
2BH032
2BH028
2BH029
2BH030
2BH034
845
2BH036
2BH035
2-MW-24A
2BH037
2BH039
2BH040
2BH041

Soil Sample Locations with Concrete Cores Collected

Additional 2007 Soil Sample Locations

Soil Sample Locations

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 30 60 120 Feet

Note: Aerial Photo taken in September 2005

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AOC 2 Soil Sampling Locations

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Test Pit Locations

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 25 50 100 Feet

Notes:
1. Aerial Photo taken in September 2005
2. No soil samples were collected in AOC 2 test pits; only direct measurements were taken.

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Test Pit Sampling Locations
AOC 2 F Parking Corral

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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N

Additional 2007 Groundwater Sample Locations

Well Locations

Former Drainge Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Locations

0 35 70 140 Feet

Note: Aerial Photo taken in September 2005

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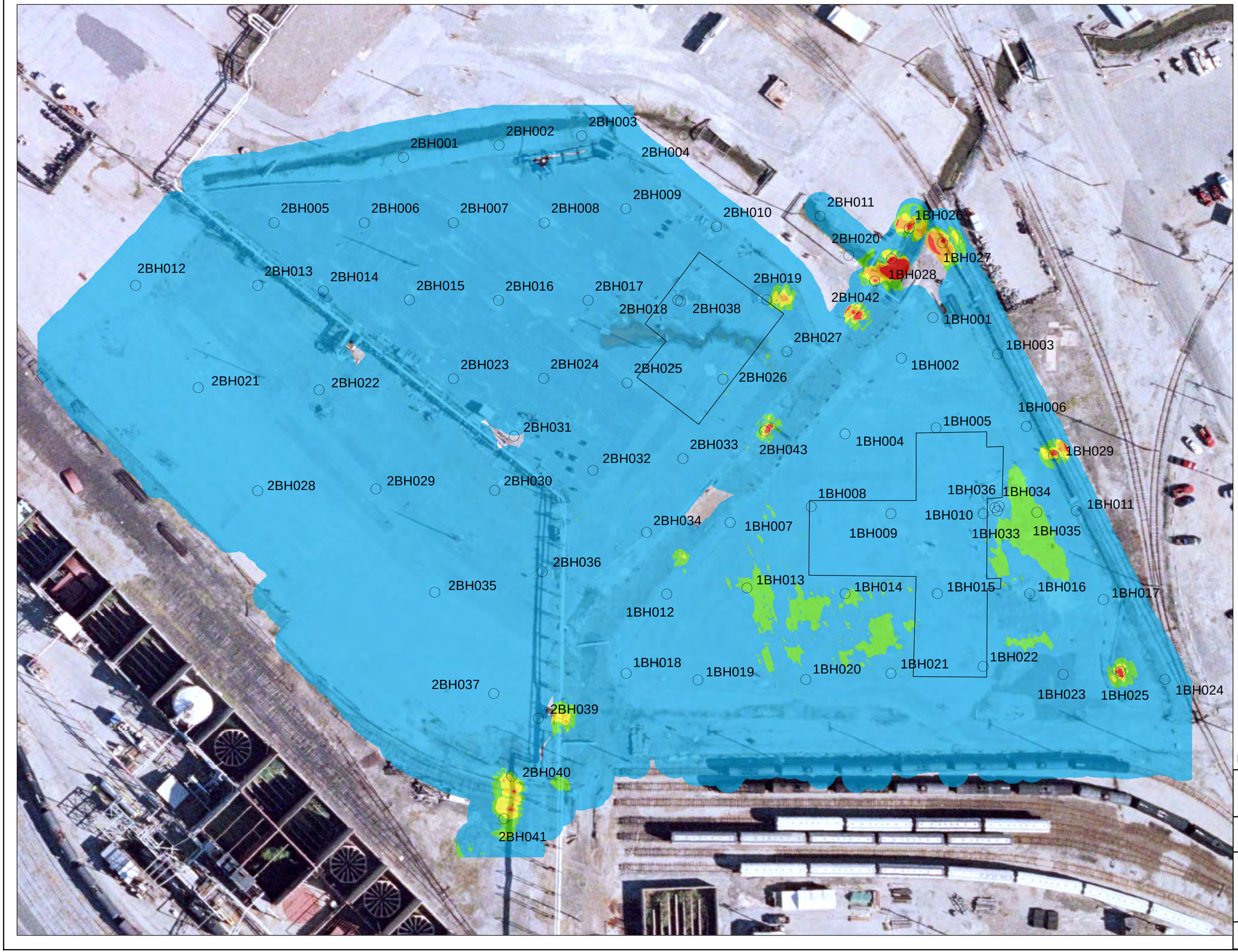
Final Monitoring Well Locations AOCs 1 and 2

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 4 - 7



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Soil Boring Locations

Buildings 845 and 708

1m Contour for Z-Score

- < 1
- 1 - 2
- 2 - 3
- 3 - 4
- > 4

0 37.5 75 150 Feet

Note: Aerial Photo taken in September 2005

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AOCs 1 and 2
Gamma Walkover Survey Results

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 8

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1BH026
78 (0.75')

1BH027
86 (0.75')

1BH028
4 (0.75')

1BH001
50 (0.75')

1BH002
127 (0.75')

1BH003
41 (0.75')

1-MW-07B
5 (8.5')

1-MW-06A
6 (2.5')

1BH004
14 (0.75')

1BH005
10 (4.25')

1BH006
7 (6')

1BH029
62 (1')

1-SB-01
414 (2.5')

1-CPT-06B
18 (1.5')

1BH034
677 (0.75')

1TP022
652 (1.25')

1TP023
121 (1.25')

1TP018
27600 (1.75')

1BH036
99043 (0.5')

1TP017
24 (1.25')

1-MW-08A
270 (4.25')

1TP001
15 (1.75')

1-SB-05
545 (3.5')

1BH035
104 (0.75')

1BH011
6 (0.75')

1BH008
8 (7.25')

1BH010
23 (0.375')

1TP015
14 (1.75')

1TP014
5 (1.75')

1BH009
579 (0.75')

1BH033
3 (2.75')

1TP013
11 (1.25')

1-SB-02
15 (1.5')

845

1TP004
7 (1.75')

1BH007
4 (14.25')

1TP007
133 (1.75')

1-SB-04
46 (1.5')

1TP025

1-SB-03
15 (0.5')

Elevator Shaft
177 (1')

1TP024
363 (0.475')

1BH012
5 (0.5')

1BH013
6 (7')

1BH014
27 (0.75')

1BH015
7 (0.25')

1BH016
94 (0.75')

1BH017
6 (13.5')

1BH022
28 (0.25')

1BH018
149 (1')

1-MW-17B
46 (5.25')

1BH019
5 (5.5')

1-MW-22A
3 (3.25')

1BH020
2 (14.25')

1BH021
4 (0.75')

1BH023
8 (2.1')

1BH025
15 (1')

1BH024
5 (0.75')

1-MW-21B
2 (4.25')

Total Uranium Concentrations in pCi/g and (depth in feet) below ground surface

- > 158
- 76 - 158
- 14 - 75
- 3 - 13
- < 3

1BH021 — Sample Station Location and ID

Former Drainage Ditch Location

Former Building 845

Current Drainage Ditch Location

0 20 40 80 Feet

Notes:

1. The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location

2. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Soil and Concrete Samples for AOC 1

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 4 - 9

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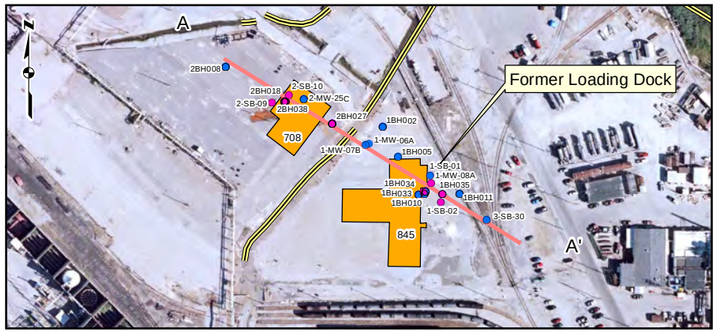
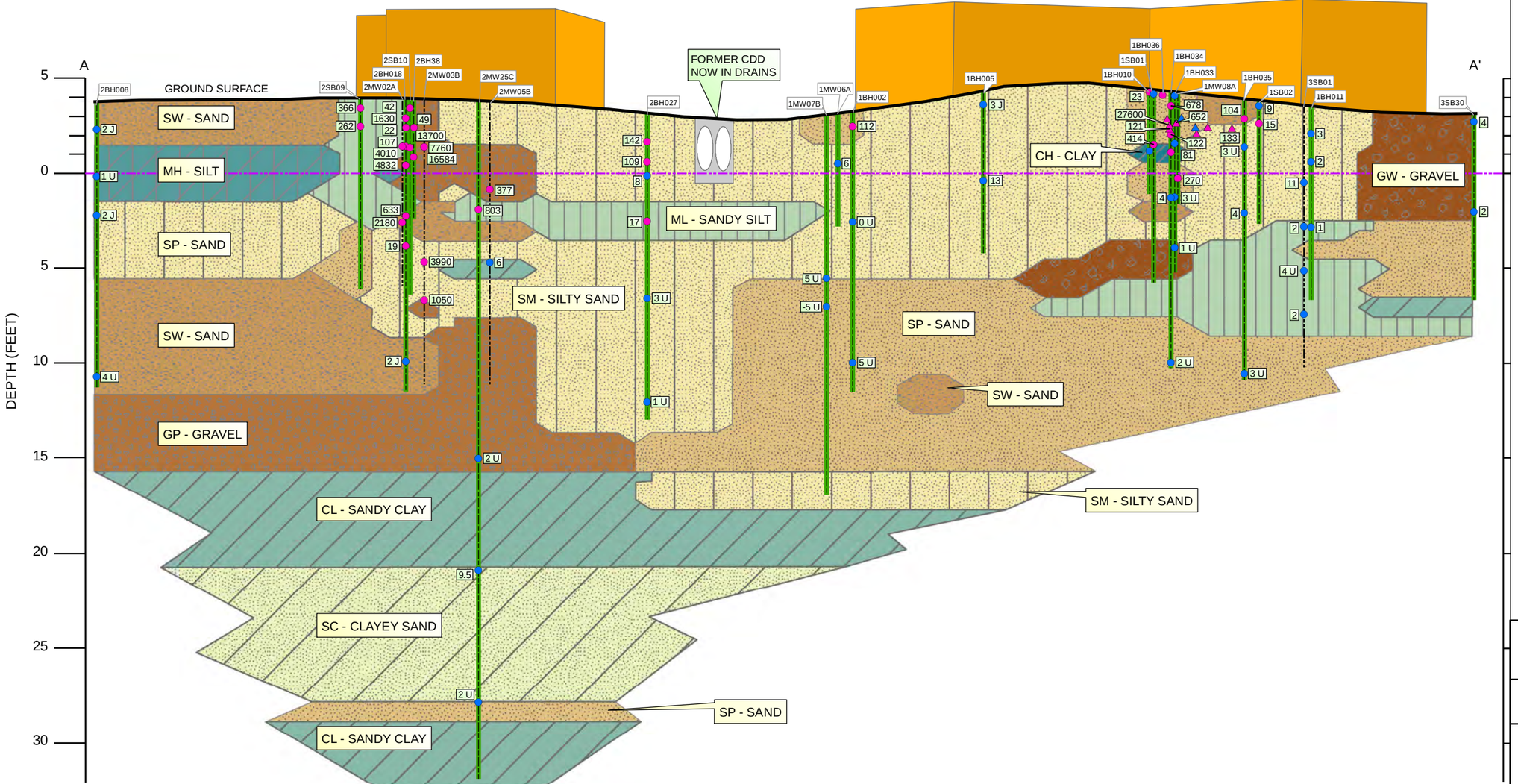


FORMER BUILDING 708

FORMER BUILDING 845



- Cross Section (A - A')
- Soil Boring
- Boring (Not used for Lithology)
- Soil Boring Sample Location
- Test Pit Sample Location

Sample Results

- Uranium Total > 14.0 pCi/g
- Uranium Total < 14.0 pCi/g
- 4 Sample Result (pCi/g)
- Drainage Ditch
- Former Building

Soil Classification

- GW - Gravel (Well Graded)
- GP - Gravel (Poorly Graded)
- SW - Sand (Well Graded)
- SP - Sand (Poorly Graded)
- SM - Silty Sand
- SC - Clayey Sand
- ML - Sandy Silt
- CL - Sandy Clay
- MH - Silt
- CH - Clay (High Plasticity)

VERTICAL EXAGGERATION = 8X

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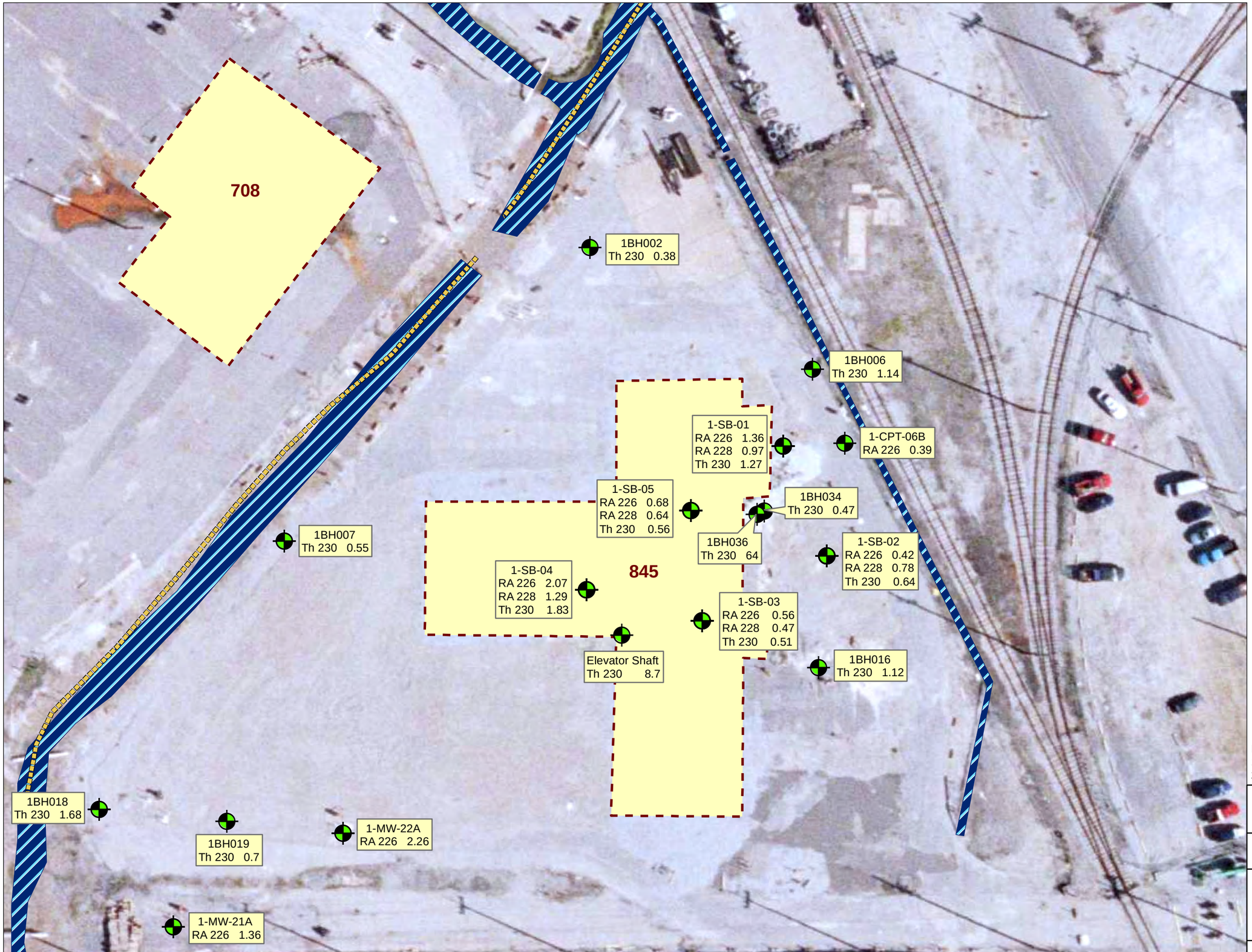
OU 1 Cross Section (A - A')

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 4 - 10



N

Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 25 50 100 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis in Soils for AOC 1

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 11

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N

2BH001 5 (1.25')
2BH002 4 (1.25')
2BH003 4 (5.75')
2BH004 12 (0.75')
2-MW-19A 3 (6.25')
2BH005 5 (13.25')
2BH006 3 (13.25')
2BH007 3 (5.75')
2BH008 2 (5.75')
2BH009 9 (2.75')
2-MW-15A 7 (2.5')
2BH010 159 (1.25')
2-MW-01B 78 (0')
2BH011 5 (0.75')
2-MW-23B 4 (2.25')
2BH020 132 (1')
2-SB-06 309 (2.5')
2-MW-02A 2180 (6.5')
2-SB-10 13700 (2.5')
2-MW-12A 10 (4.5')
2-MW-20A 220 (1.25')
2BH042 385 (0.75')
2BH013 2 (1.25')
2BH014 6 (5.75')
2BH012 4 (1.25')
2-MW-16B 3 (6.5')
2BH015 5 (8.4')
2BH016 5 (12.75')
2BH017 2 (1.75')
2BH018 4832 (3.25')
2BH019 2 (6.2')
2-SB-09 366(.5')
2-SB-07 800 (1.5')
2-MW-04B 5 (8.25')
2BH038 16548 (2.75')
2-MW-03B 7760 (2.5')
2-MW-25C 803 (5.5')
2-MW-05B 377 (4.5')
2BH027 142 (1')
708
2BH024 2 (6.15')
2BH022 4 (5.75')
2BH021 7 (1.75')
2BH023 3 (2.5')
2BH025 34 (2.75')
2BH026 23 (4.25')
2-SB-08 3 (0.5')
2-MW-26A 1 (9.25')
2BH043 238 (.25')
2BH031 4 (9.35')
2BH032 7 (8.62')
2BH033 3 (10.25')
2BH028 3 (1.25')
2BH029 4 (2.75')
2BH030 7 (5.75')
2BH034 5 (5.75')
845
2BH036 10 (5.75')
2-MW-24A 1 (6.75')
2BH035 3 (6.25')
2BH037 9 (5.75')
2BH039 8 (1.25')
2BH040 3 (5.75')
2BH041 2 (5.75')

Total Uranium Concentrations in pCi/g and (depth in feet) below ground surface

- > 158
- 76 - 158
- 14 - 75
- 3 - 13
- < 3

2BH026 — Sample Station Location and ID

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 35 70 140 Feet

Notes:

1. The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location.
2. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Soil Samples for AOC 2

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 12

N

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Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 25 50 100 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis in Soils for AOC 2

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 4 - 13**

N

031003

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1BH018 Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Building 845

Current Drainage Ditch Location

0 25 50 100 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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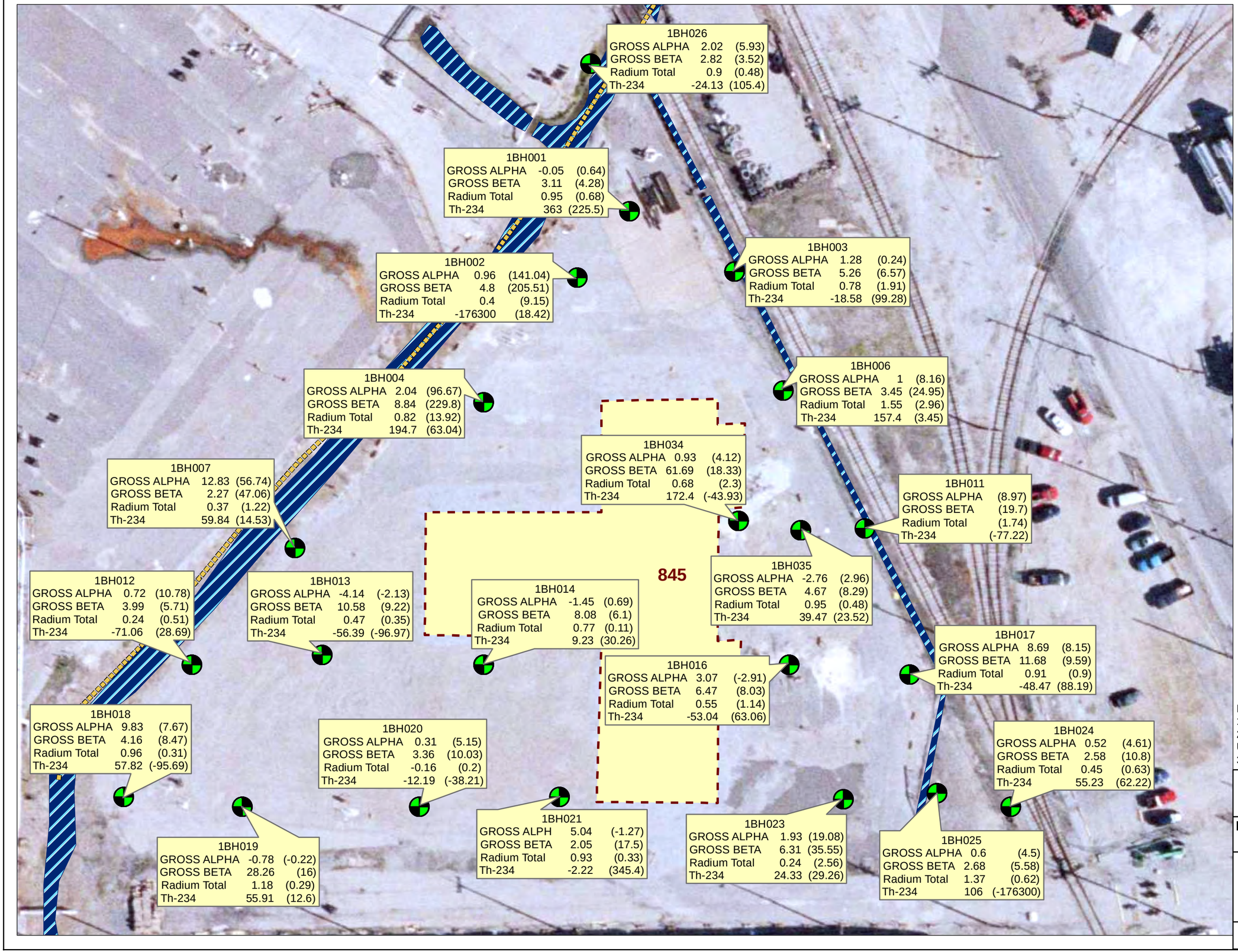
Total Uranium in Groundwater
Geoprobe Samples - AOC 1

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	**Figure 4 - 14**



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FINAL

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Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Building 845

Current Drainage Ditch Location

0 25 50 100 Feet

Notes:
1. All results reported in picoCuries per liter (pCi/L)
2. Both Filtered and Unfiltered results are presented; Unfiltered results are shown in parentheses.
3. Aerial Photo taken in September 2005

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Radiochemical Analysis of Groundwater Geoprobe Samples - AOC 1

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 15

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2BH016 — Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 35 70 140 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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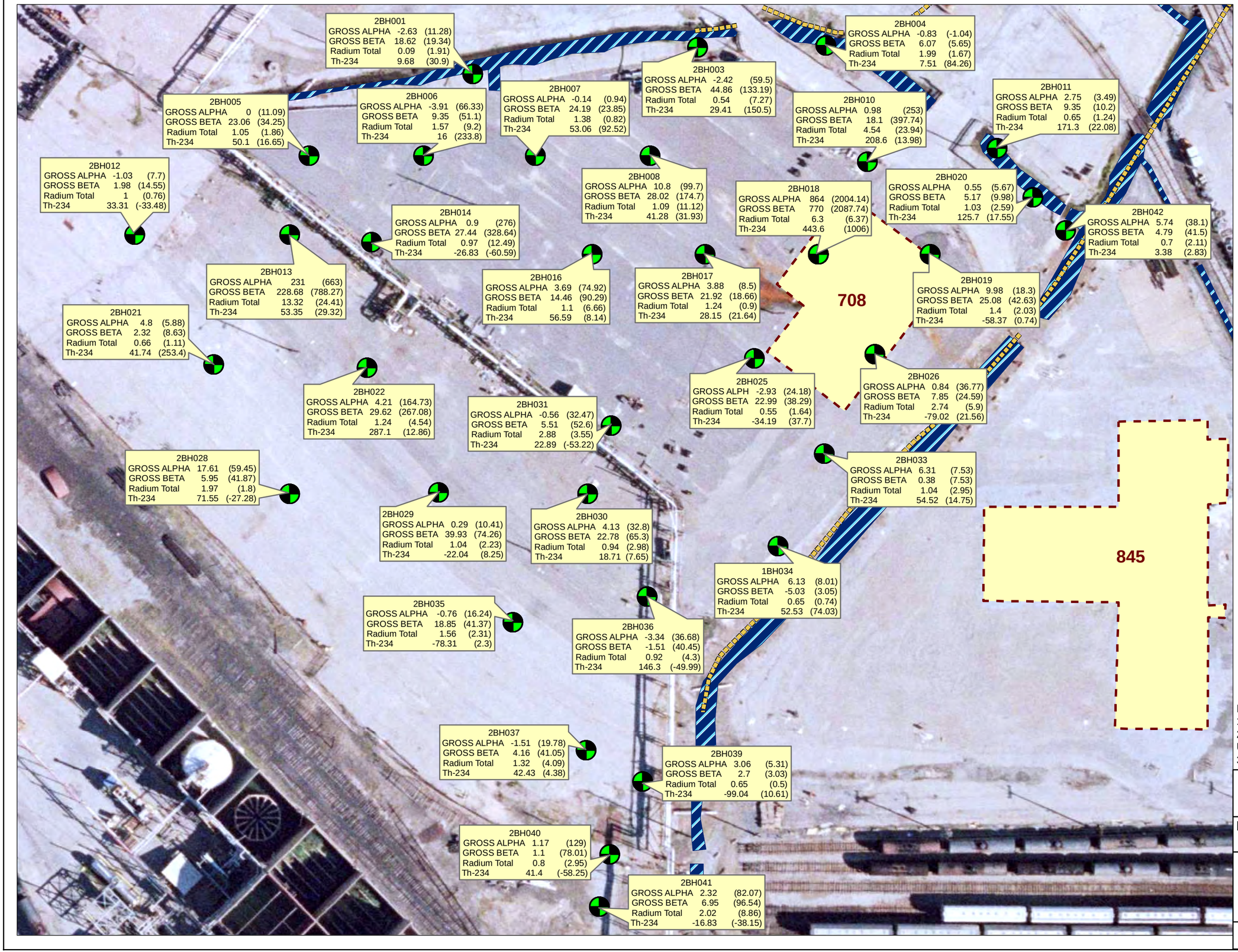
Total Uranium in Groundwater Geoprobe Samples - AOC 2

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 16



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FINAL

DO NOT CITE OR QUOTE

Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 35 70 140 Feet

Notes:
1. All results reported in picoCuries per liter (pCi/L)
2. Both Filtered and unfiltered results are presented; Unfiltered results are shown in parenthesis.
3. Aerial Photo taken in September 2005

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Radiochemical Analysis of Groundwater Geoprobe Samples - AOC 2

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 17

N

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Aquifer "A" Well

2.93 Groundwater Elevation Ft NAVD 88

2 Groundwater Elevation Contour Contour Interval 1 Foot

(Arrow indicates Groundwater Flow Direction)

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 25 50 100 Feet

Note: Aerial Photo taken in September 2005

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Groundwater Elevation
"A" Aquifer OU 1 - Quarter 5 (Sept 2006)

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
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Deepwater, New Jersey

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- Aquifer "B" Well
- 0.99 — Groundwater Elevation Ft NAVD 88
- NM — Not Measured
- 1 — Groundwater Elevation Contour Contour Interval 0.5 Foot
- (Arrow indicates Groundwater Flow Direction)
- Former Drainage Ditch Location
- Former Buildings 845 and 708
- Current Drainage Ditch Location

0 40 80 160 Feet

Note: Aerial Photo taken in September 2005

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Groundwater Elevation "B" Aquifer OU 1 - Quarter 5 (Sept 2006)

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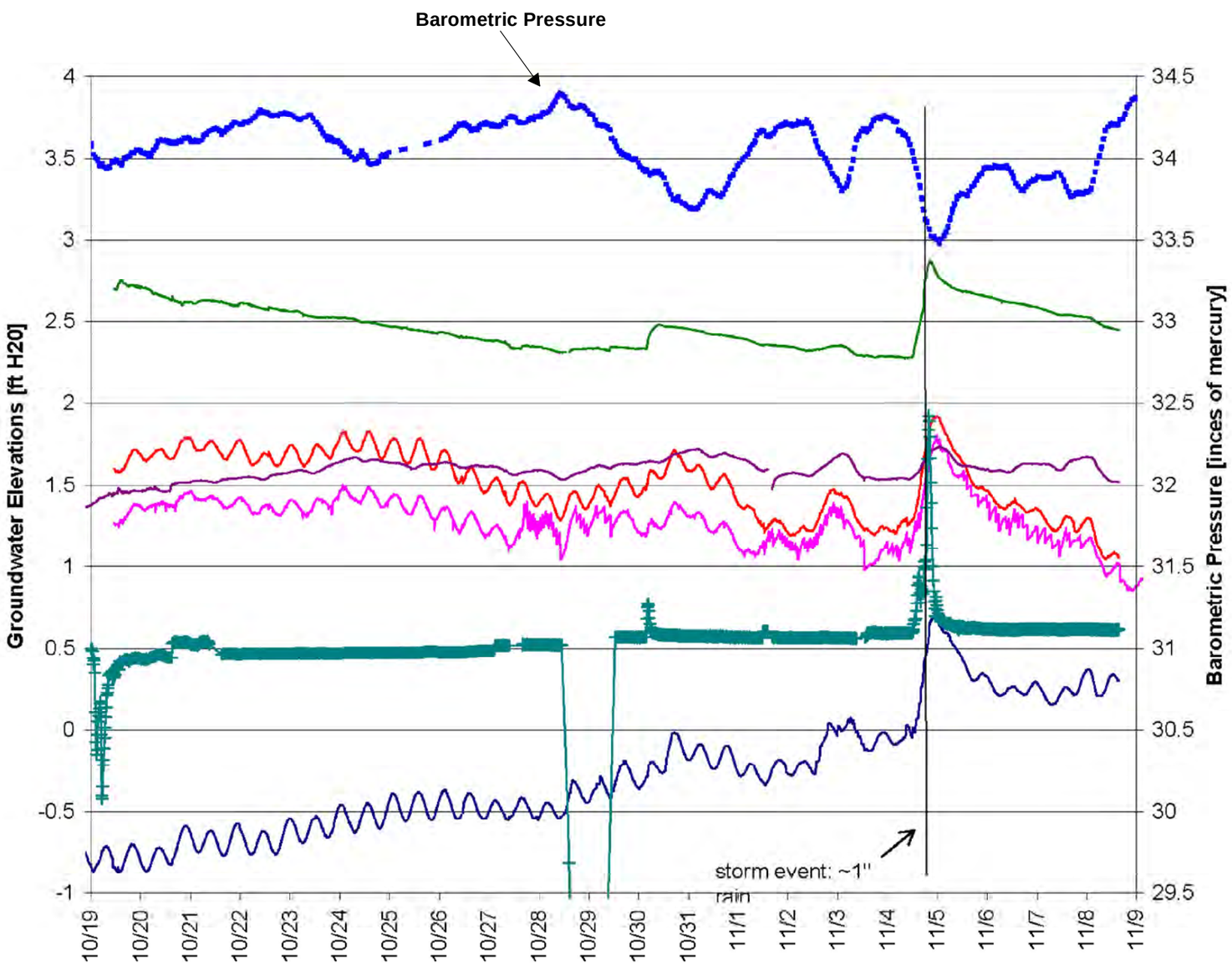

MW-01
MW-03
MW-04
MW-12
MW-15
CDD
Barometric Pressure

Notes:
1. Observations collected Fall 2004
2. Aerial Photo taken in September 2005

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Variation in Water Levels and Barometric Pressure

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Deepwater, New Jersey

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Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 35 70 140 Feet

Notes:
1. Dissolved Oxygen (DO) is reported in mg/L
2. Oxygen Reduction Potential (ORP) is reported in millivolts
3. Aerial Photo taken in September 2005

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Average DO and ORP Values in Groundwater for OU 1

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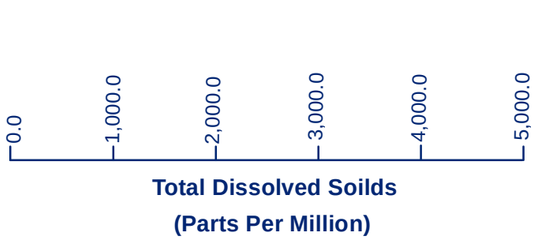
Piper Diagram

OU 1 Quarter 4



Aquifer

○	1	B
●	2	A
○	3	B
○	4	B
○	5	B
●	6	A
○	7	B
●	8	A
○	9	B
●	10	A
○	11	B
●	12	A
○	13	B
○	14	B
●	15	A
○	16	B
○	17	B
●	18	A
●	19	A
●	20	A
●	21	A
●	22	A
○	23	B
●	24	A
●	26	A

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Piper Diagram - OU 1 Quarter 4

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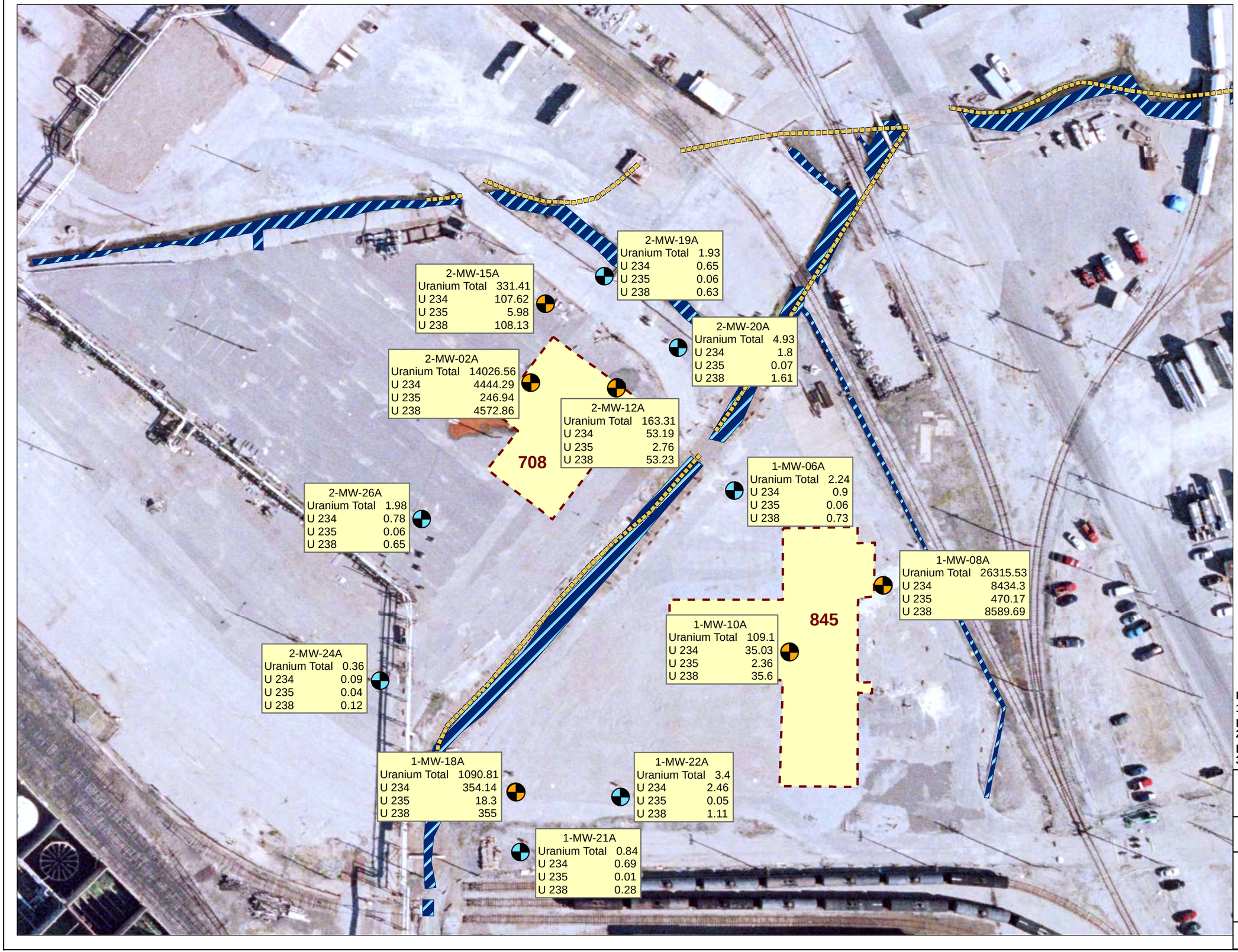
June 2011 | Figure 4 - 22



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Monitoring Well Location with total uranium results above 30 micrograms per liter (ug/L)

Monitoring Well Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 37.5 75 150 Feet

Notes:

1. Total Uranium results are reported in micrograms per liter (ug/L)

2. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)

3. Aerial Photo taken in September 2005

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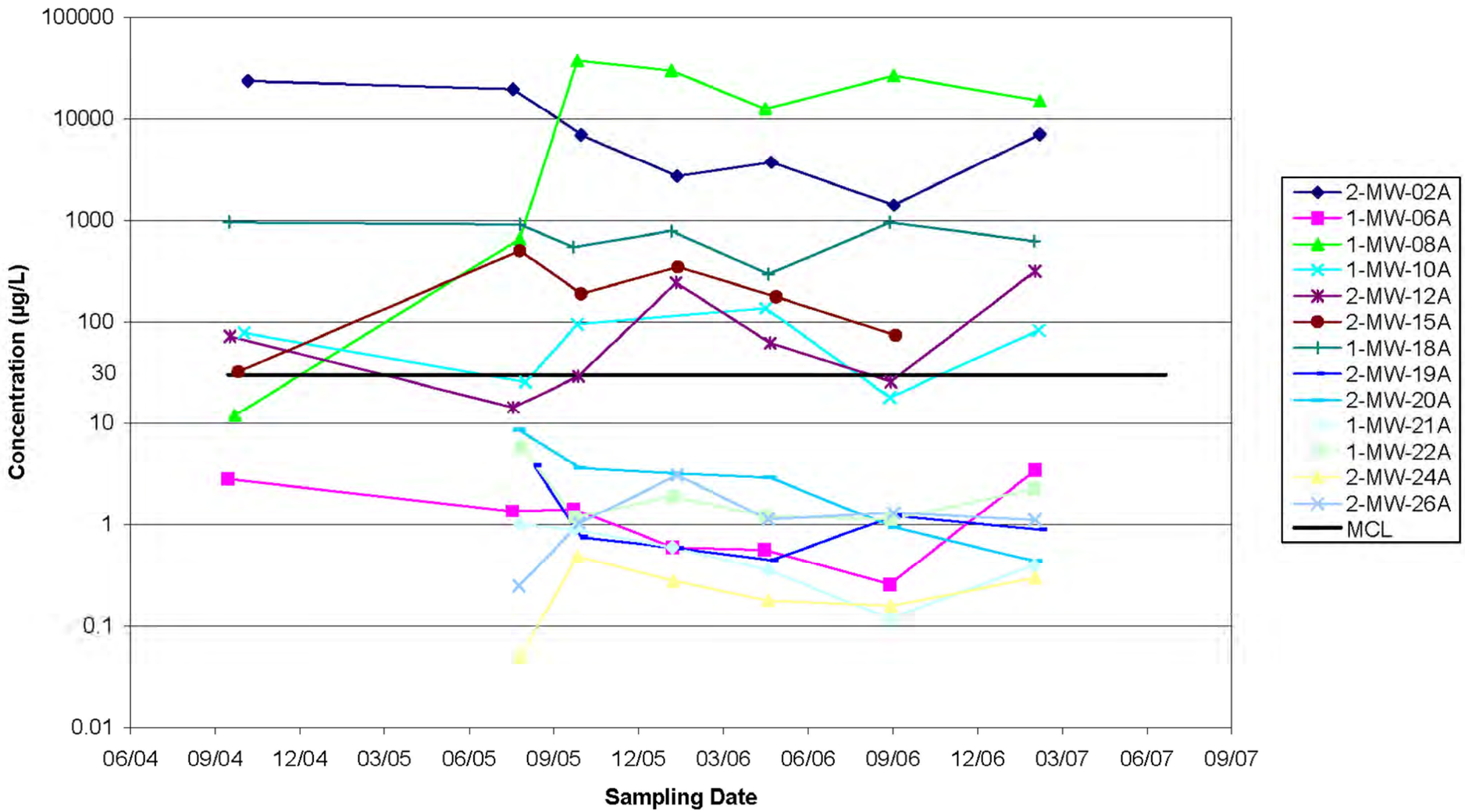
Average Isotopic and Total Uranium for OU 1 - "A" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 4 - 23**

Total Uranium Concentrations In Unfiltered Groundwater
Operable Units 1 & 2, Aquifer A
DuPont Chambers Works



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Total Uranium Concentration Trends
OU's 1 and 2 - "A" Aquifer

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USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Monitoring Well Location

Total Uranium results that exceeds 30 micograms per Liter (ug/L)

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

Average Groundwater Flow Direction

0 40 80 160 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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Average Uranium Isopleth Map for OU 1, "A" Aquifer

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Monitoring Well Location with total uranium results above 30 micrograms per liter (ug/L)

Monitoring Well Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 37.5 75 150 Feet

Notes:

1. Total Uranium results are reported in micrograms per liter (ug/L)
2. Well 2MW-25C is completed in the C Aquifer to evaluate vertical migration
3. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)
4. Aerial Photo taken in September 2005

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Average Isotopic and Total Uranium for OU 1 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
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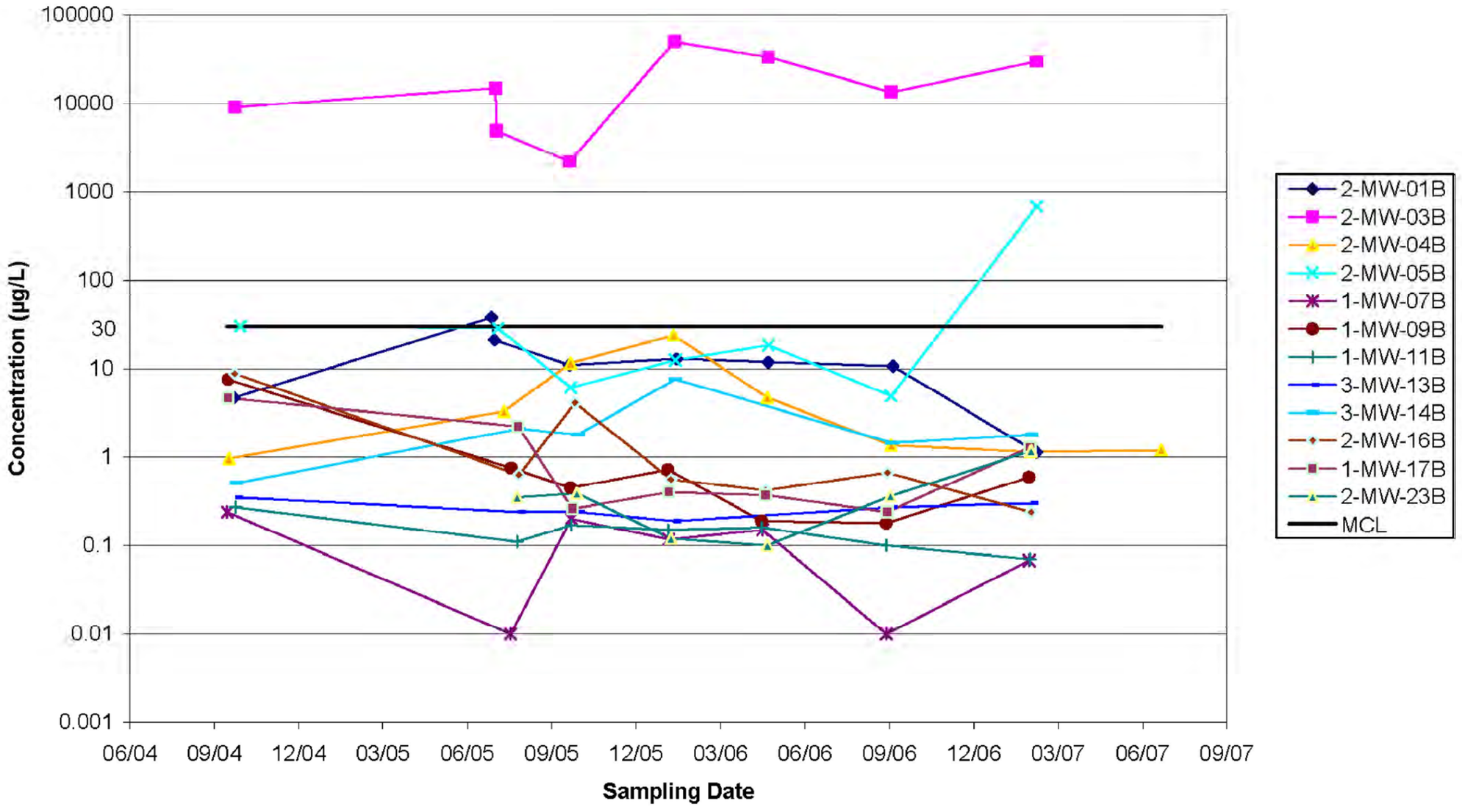
Deepwater, New Jersey

June 2011 | **Figure 4 - 26**

Total Uranium Concentrations In Unfiltered Groundwater
Operable Units 1 & 2, Aquifer B
DuPont Chambers Works



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Total Uranium Concentration Trends
OU's 1 and 2 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Monitoring Well Location

Total Uranium results that exceeds 30 micograms per liter (ug/L)

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

Average Groundwater Flow Direction

0 37.5 75 150 Feet

Notes:

1. Total Uranium results are reported in micrograms per liter (ug/L)

2. Well 2MW-25C is completed in the C Aquifer to evaluate vertical migration

3. Aerial Photo taken in September 2005

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Average Uranium Concentrations in OU 1, "B" Aquifer

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USACE- FUSRAP
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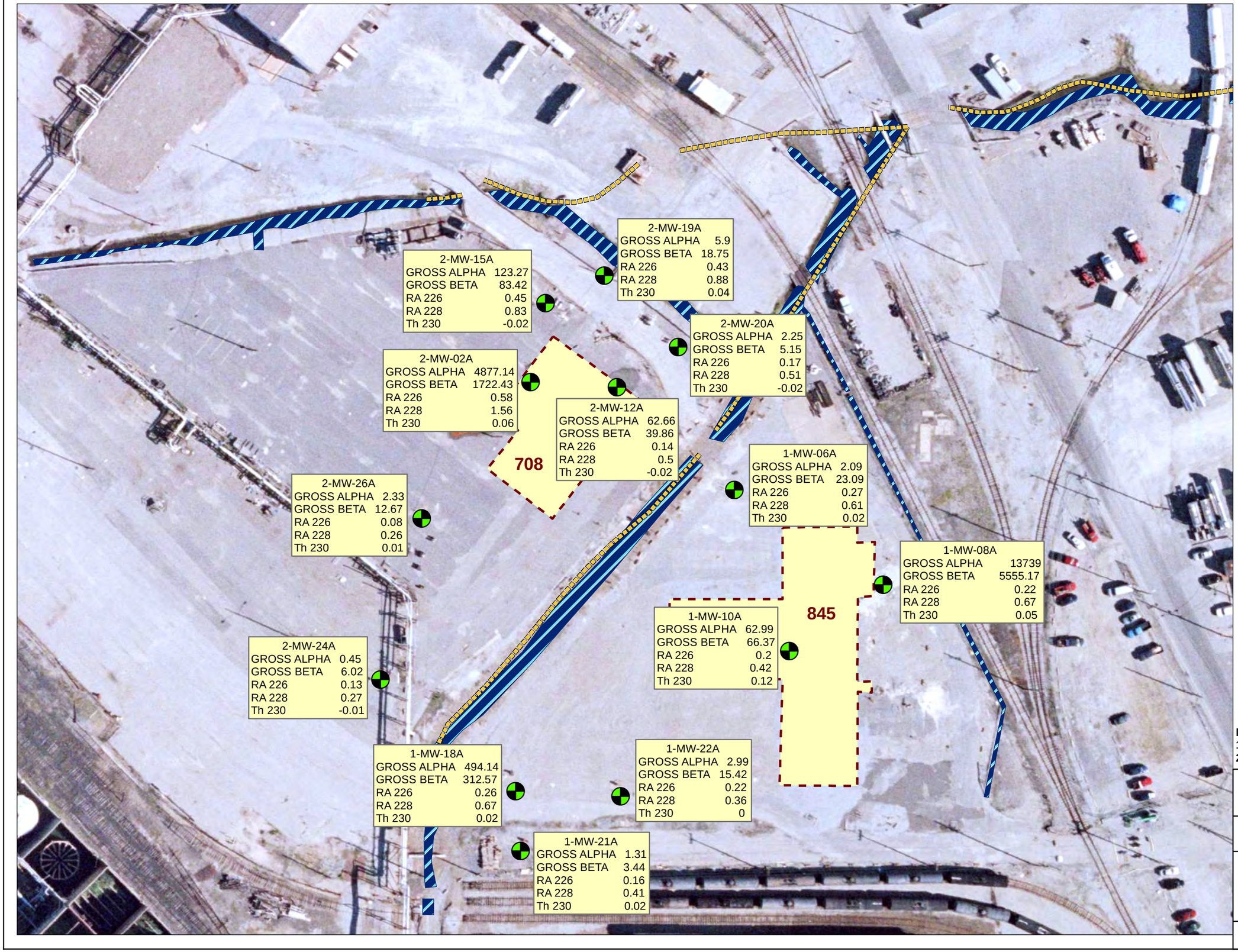

Monitoring Well Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 37.5 75 150 Feet

Notes:

1. All results are reported in picoCuries per liter (pCi/L)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis for OU 1 - "A" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
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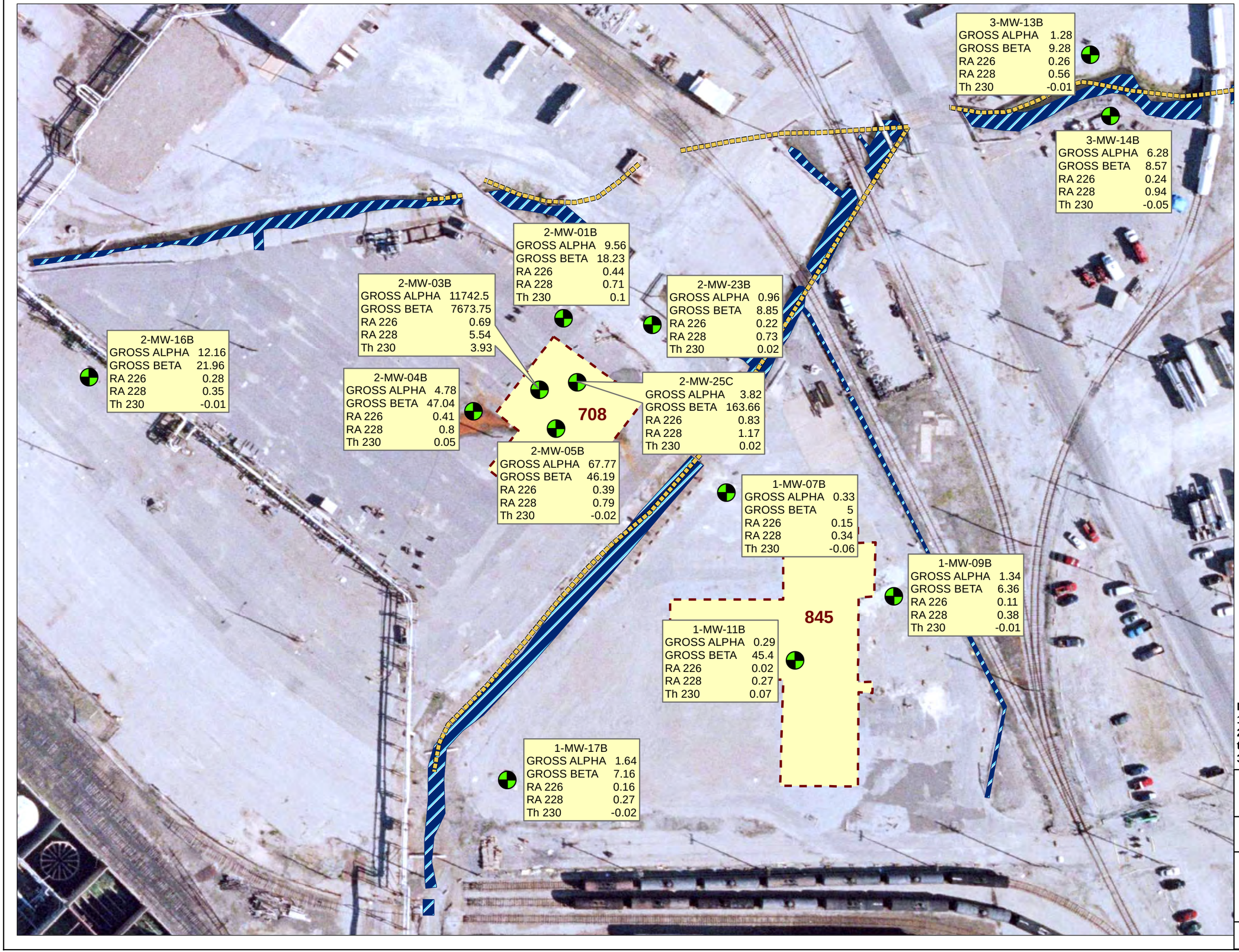
Deepwater, New Jersey

June 2011 | Figure 4 - 29



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N

Monitoring Well Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 37.5 75 150 Feet

Notes:

1. All results are reported in picoCuries per liter (pCi/L)
2. Well 2-MW-25C is completed in the C Aquifer to evaluate vertical migration
3. Aerial Photo taken in September 2005

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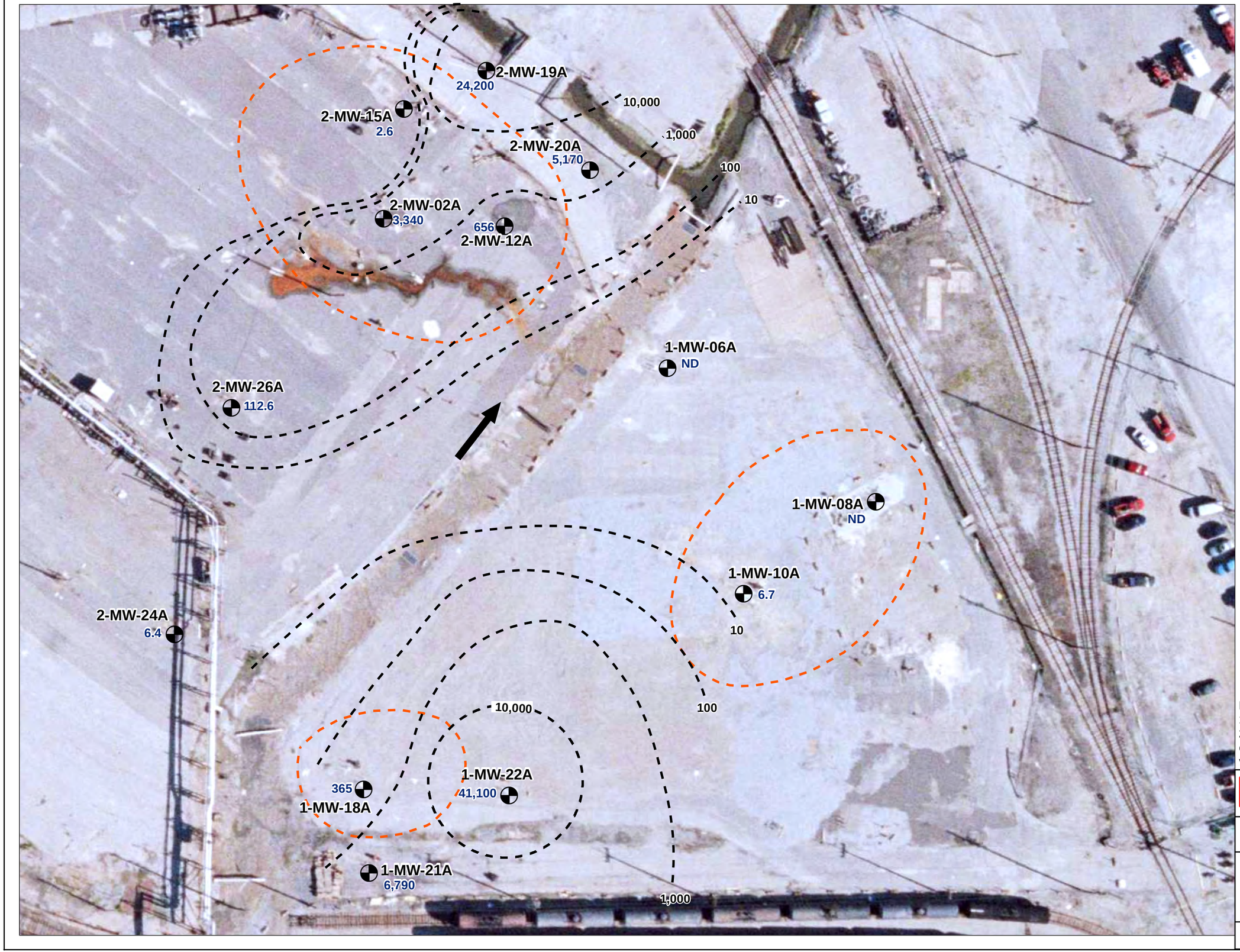
Radiochemical Analysis for OU 1 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 30



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1-MW-21A	Aquifer A Well
2.6	BTEX Conc. (ug/L)
ND	Not Detected
- - -	BTEX Isopleth (ug/L)
	Uranium Total results that exceeds 30 micrograms per Liter (ug/L)
	Groundwater Flow Direction

0 30 60 120 Feet

Notes:
1. Aerial Photo taken in September 2005
2. BTEX stands for benzene, toulene, ethylbenzene and xylene which is a group of volatile organic compounds (VOCs)

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BTEX Isopleth Map
OU 1 & OU 2 - Aquifer "A" - Quarter 1

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1-MW-11B	Aquifer B Well
2.6	BTEX Conc. (ug/L)
ND	Not Detected
- - -	BTEX Isopleth (ug/L)
	Uranium Total results that exceeds 30 micrograms per Liter (ug/L)
	Groundwater Flow Direction in B Aquifer

0 40 80 160 Feet

Notes:
1. Aerial Photo taken in September 2005
2. BTEX stands for benzene, toluene, ethylbenzene and xylene which is a group of volatile organic compounds (VOCs)

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BTEX Isopleth Map
OU 1 & OU 2 - Aquifer "B" - Quarter 1

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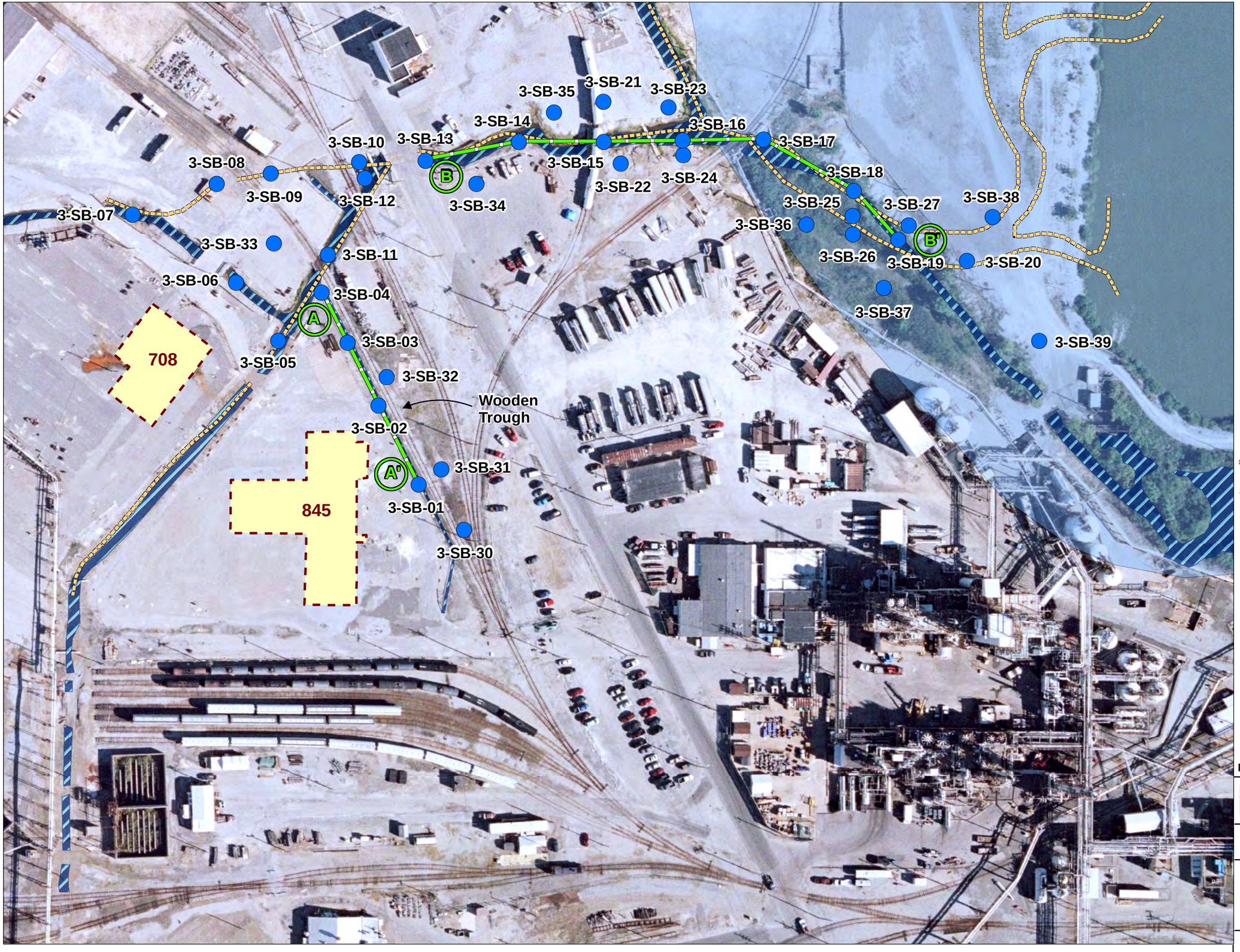
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 4 - 32



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- Completed Sampling Locations
- Cross Section Locations
- Former Drainage Ditch Location
- Former Buildings 845 and 708
- Current Drainage Ditch Location
- Historic Lagoon Area

0 65 130 260 Feet

Note: Aerial Photo taken in September 2005

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AOC 3 Central Drainage Ditch Location of Cross Sections A-A' and B-B'

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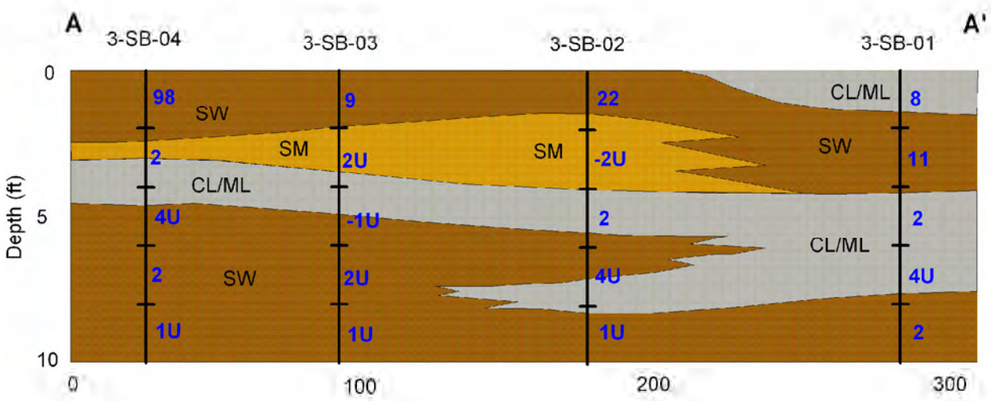
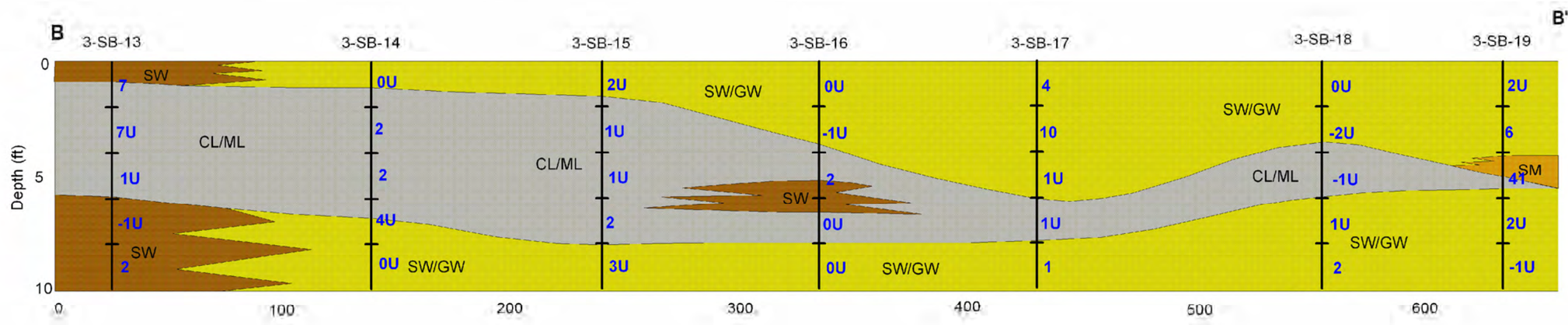
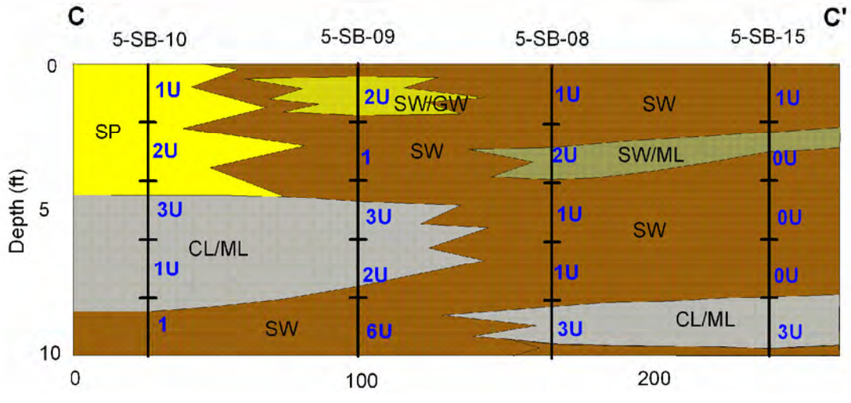
June 2011 | Figure 5 - 1







Notes:
1. Cross sections showing Utot concentrations in soil samples, (in pCi/g) using onsite gamma spec results.
2. Locations of A-A' and B-B' cross sections are presented in Figure 5-1. The location for cross section C-C' is shown on Figure 5-3.

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Geologic Cross Sections A-A', B-B' (AOC 3) and C-C' (AOC 5)

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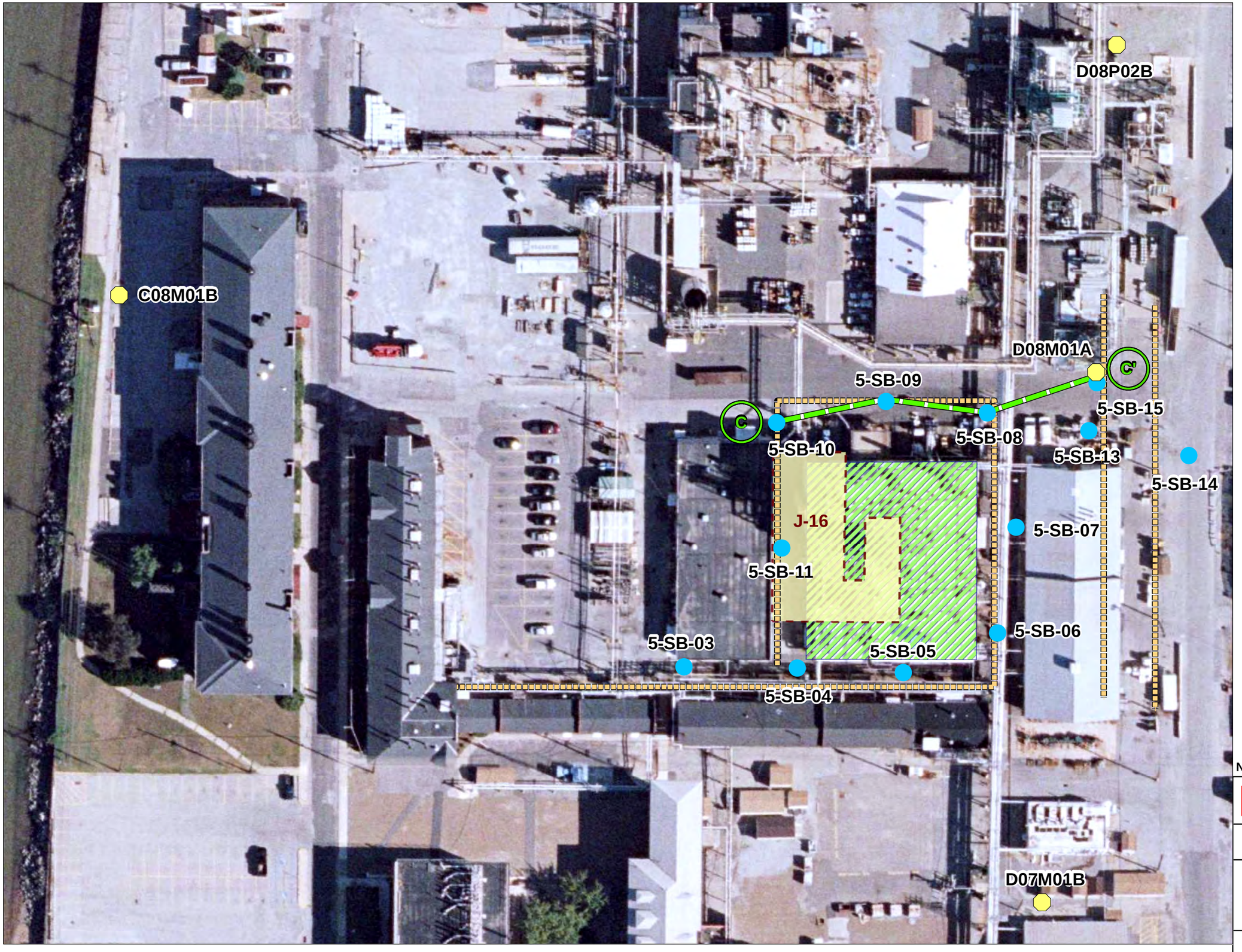
Deepwater, New Jersey

June 2011 | **Figure 5 - 2**



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- Existing DuPont Well Locations
- Soil Boring Locations
- Cross Section Location
- Former Drainage Ditch Location
- Former Building J-16
- Current J-26 Building

0 35 70 140 Feet

Note: Aerial Photo taken in September 2005

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AOC 5 Building J-26 Area
Location of Cross Section C-C'

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USACE - FUSRAP
DuPont Chambers Works
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AOC 3

AOC 5

2 B Aquifer Groundwater Elevation Contour (in feet below ground surface)

0 700 1,400 2,800 Feet

Notes:
1. Source: USGS 7.5" Series Quads. Wilmington South & Penns Grove, NJ, DEL 1967, photo revised respectively 1987 & 1988
2. Groundwater flow in AOC 3 and AOC 5 (B Aquifer) is to northeast.

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"B" Aquifer Piezometric Surface

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DuPont Chambers Works
Deepwater, New Jersey

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Location of Paleochannel

Chambers Works Site

0 7,000 14,000 28,000 Feet

Image Source: Google Earth

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Former Channels of Delaware River

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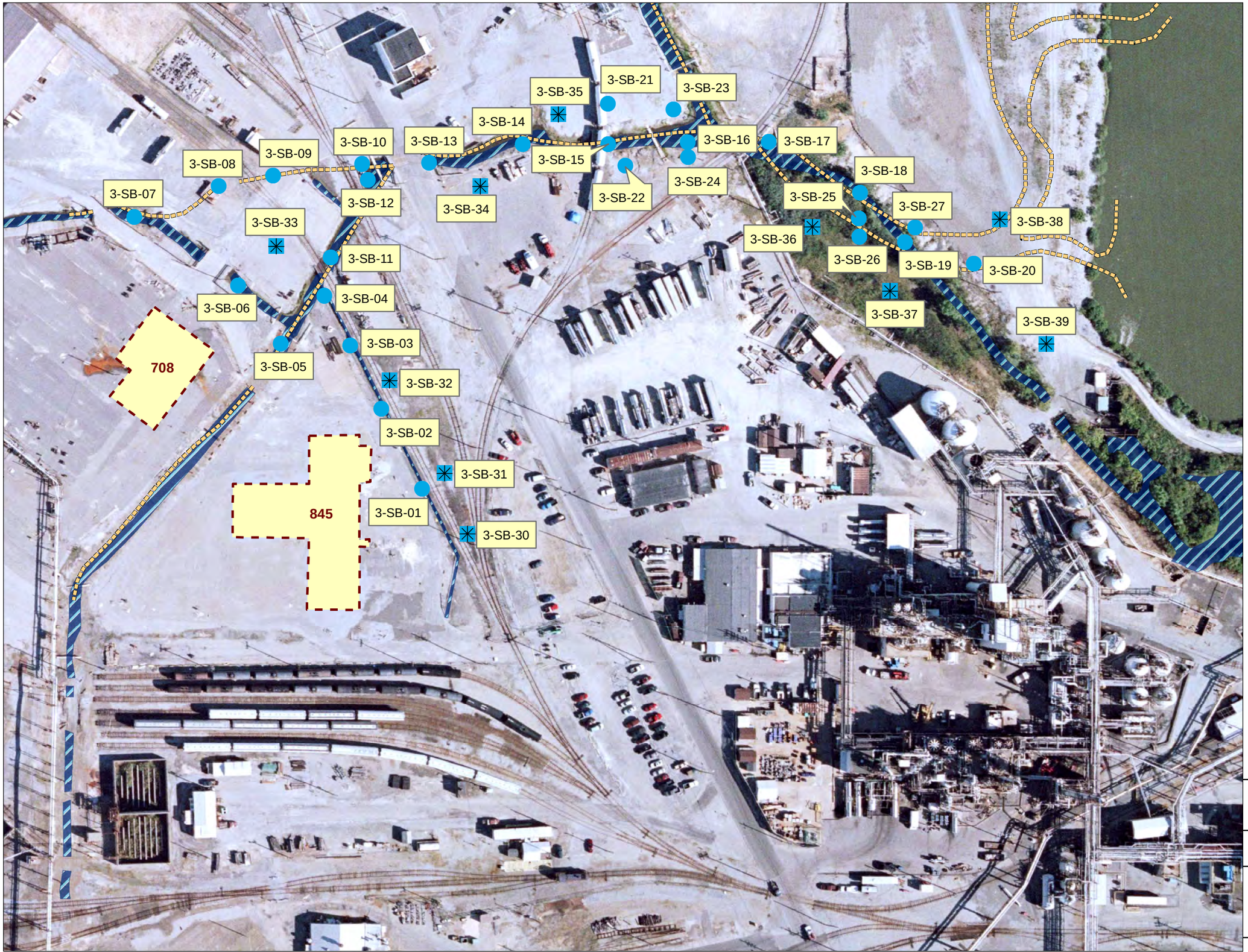
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 5



Additional 2007 Soil Sampling Locations

Soil Sampling Locations

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 62.5 125 250 Feet

Note: Aerial Photo taken in September 2005

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AOC 3 Central Drainage Ditch Completed Soil Sampling Locations

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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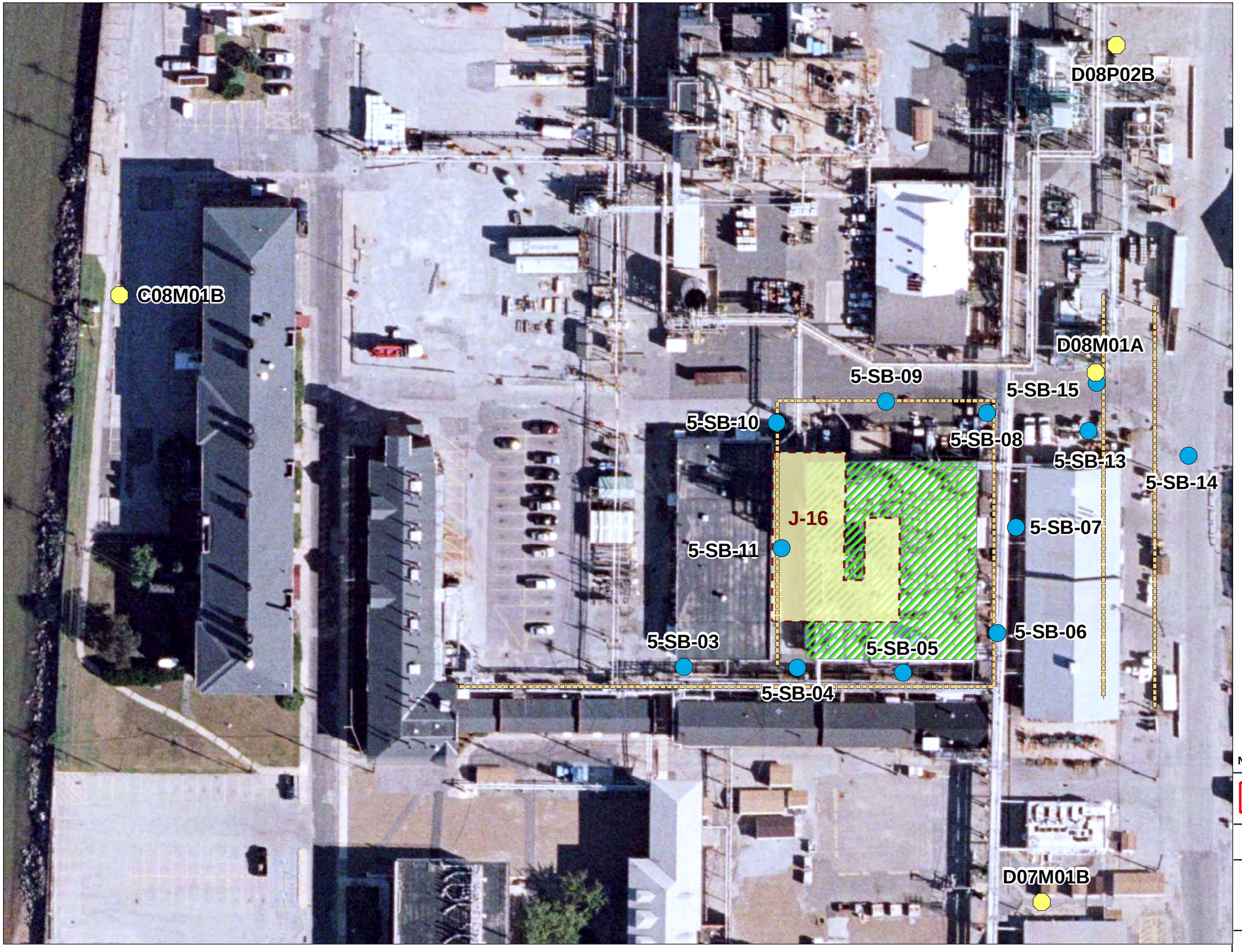

Existing DuPont Well Locations

Soil Boring Locations

Former Drainage Ditch Location

Former Building J-16

Current J-26 Building

0 35 70 140 Feet

Note: Aerial Photo taken in September 2005

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AOC 5 Building J-26 Area Completed Sampling Locations

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 7

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N

3-SB-21
3-SB-23
3-SB-35
3-SB-15
3-SB-16
3-SB-10
3-SB-13
3-SB-17
3-SB-08
3-SB-14
3-SS-28
3-SB-18
3-SB-09
3-SB-12
3-SB-22
3-SB-24
3-SB-34
3-SB-25
3-SB-27
3-SB-38
3-SB-07
3-SB-36
3-SB-33
3-SB-11
3-SB-26
3-SB-19
3-SB-20
3-SB-06
3-SB-04
3-SB-37
3-SB-05
3-SB-03
3-SB-39
3-SB-32
3-SB-02
3-SB-31
3-SB-01
3-SB-30

Sample Locations

1 m Contour of Z-Score

- < 1
- 1 - 2
- 2 - 3
- > 3

0 65 130 260 Feet

Note: Aerial Photo taken in September 2005

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AOC 3 Central Drainage Ditch Gamma Walkover Survey Results

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Total Uranium Concentrations in pCi/g and (depth in feet) below ground surface

- > 158
- 76 - 158
- 14 - 75
- 3 - 13
- < 3

3-SB-17 — Sample Station Location and ID

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 37.5 75 150 Feet

Notes:
1. The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location
2. Aerial Photo taken in September 2005

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AOC 3 Total Uranium Concentrations in Soil Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 5 - 9**

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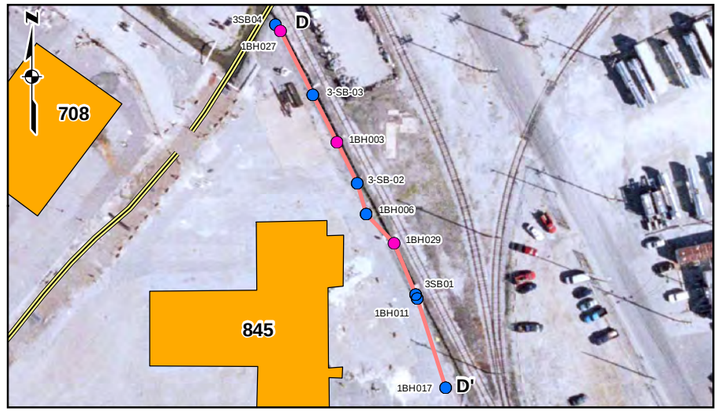

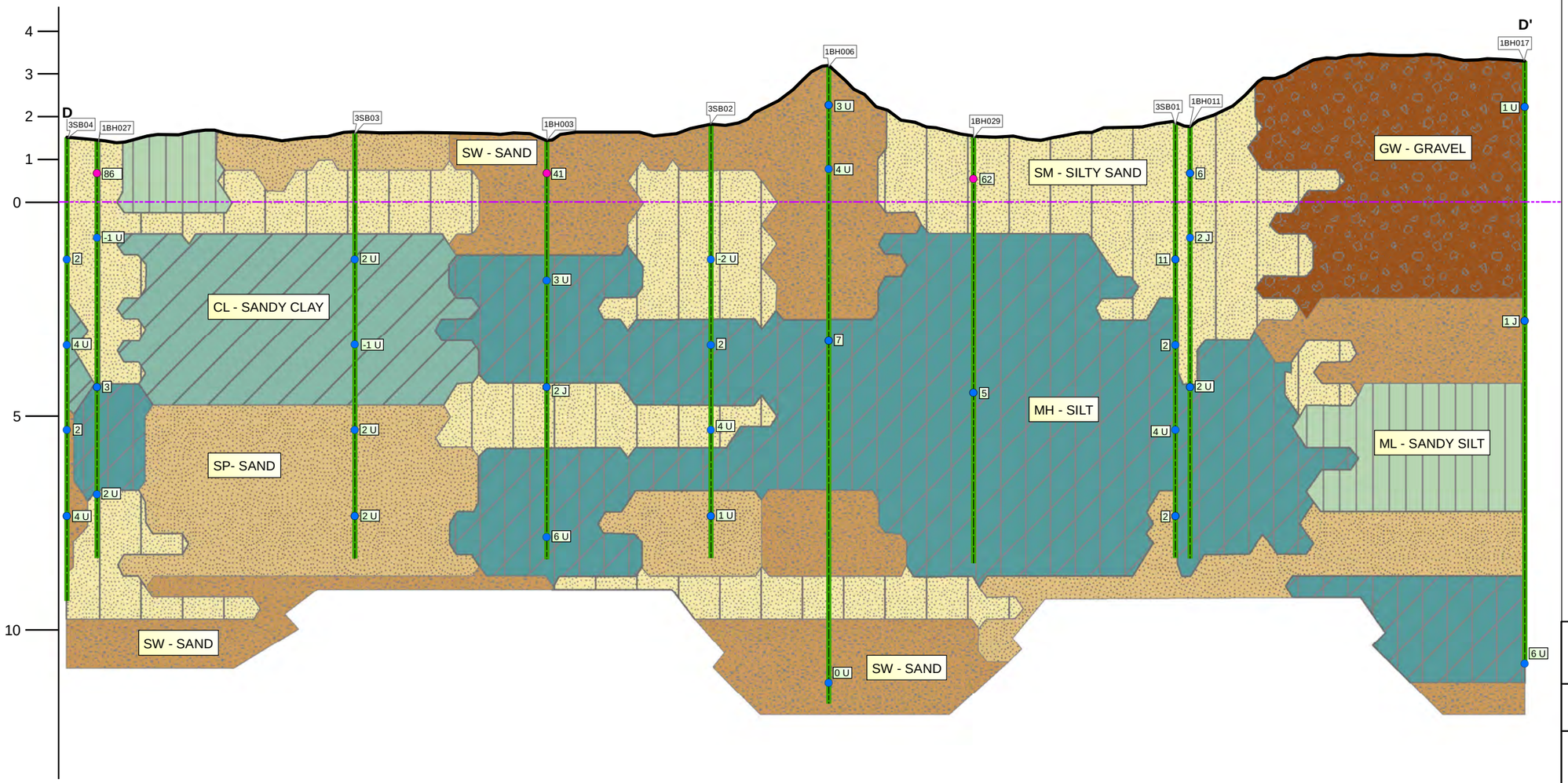

Cross Section (D - D')

Soil Boring

Drainage Ditch

Former Building

Sample Results

Uranium Total < 14 pCi/g

Uranium Total < 14 pCi/g

4 Sample Results (pCi/g)

Soil Classification

GW - Gravel (Well Graded)

GP - Gravel (Poorly Graded)

SW - Sand (Well Graded)

SP - Sand (Poorly Graded)

SM - Silty Sand

SC - Clayey Sand

ML - Sandy Silt

CL - Sandy Clay

MH - Silt

CH - Clay (High Plasticity)

VERTICAL EXAGGERATION = 10X

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AOC 3 Cross Section (D - D')
Vertical Extent of Uranium Contamination

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 5 - 10**

031003

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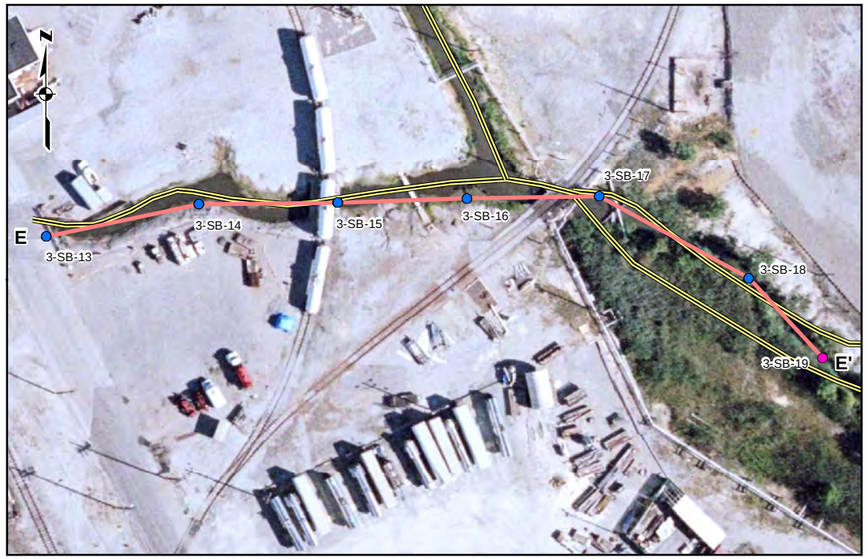

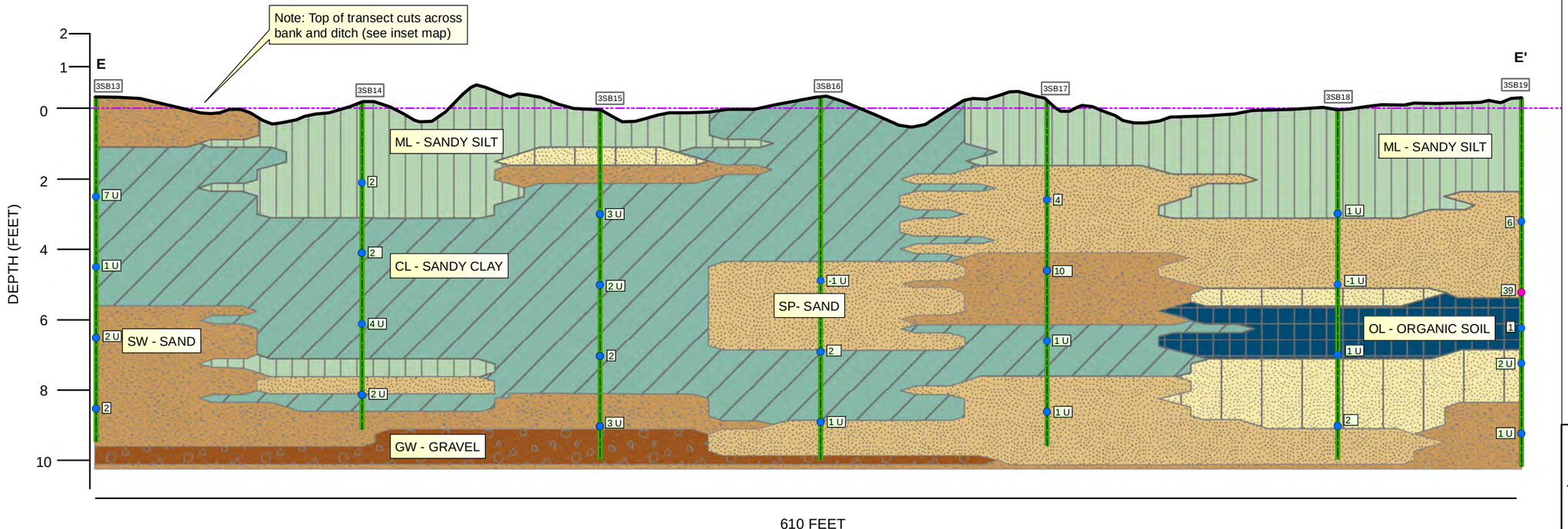

Soil Boring

Cross Section (E - E')

Drainage Ditch

Sample Results

Uranium Total < 14.0 pCi/g

Uranium Total > 14.0 pCi/g

4 Sample Results (pCi/g)

Soil Classification

GW - Gravel (Well Graded)

GP - Gravel (Poorly Graded)

SW - Sand (Well Graded)

SP - Sand (Poorly Graded)

SM - Silty Sand

SC - Clayey Sand

ML - Sandy Silt

CL - Sandy Clay

MH - Silt

CH - Clay (High Plasticity)

OL - Organic Soil

VERTICAL EXAGGERATION = 15X

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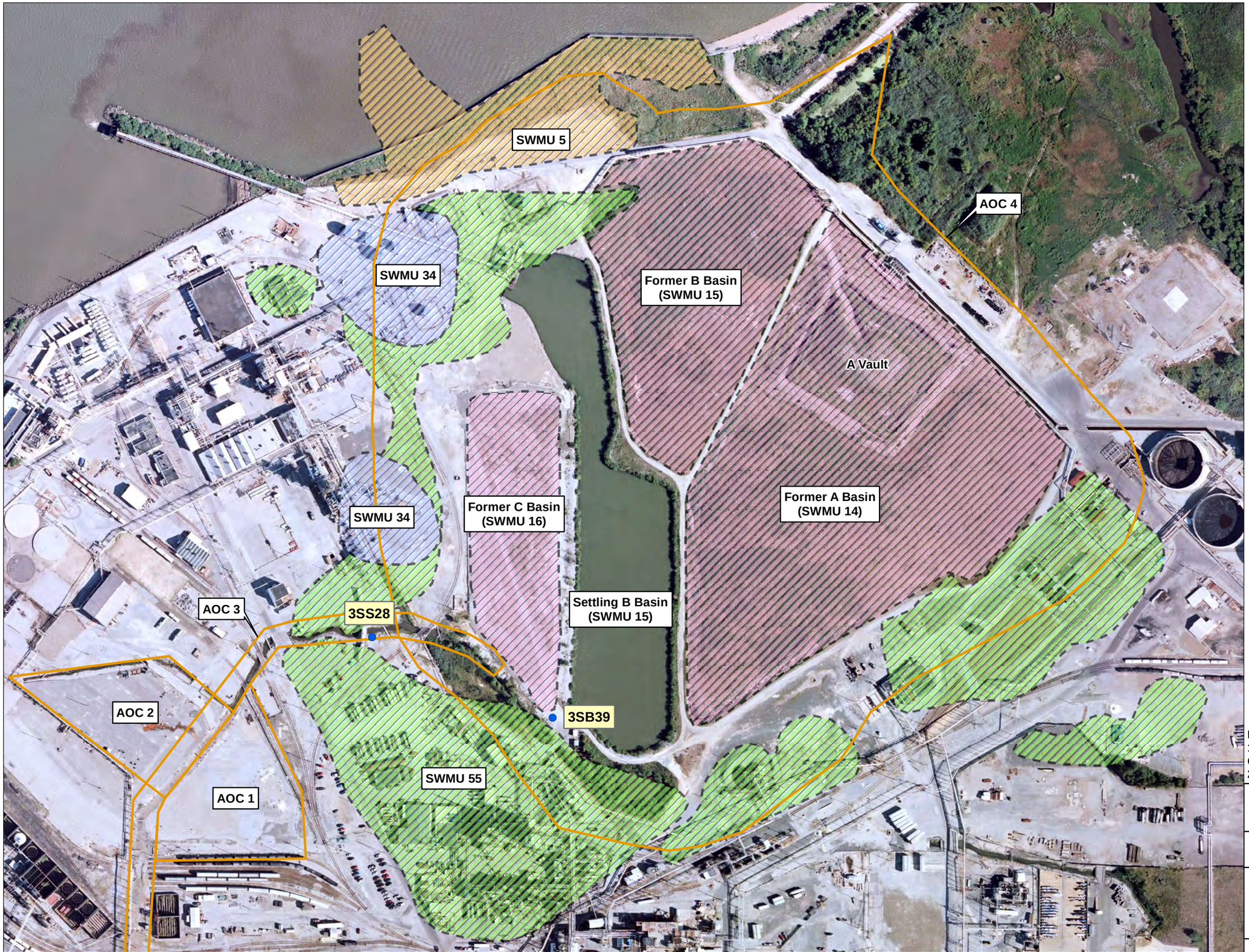
AOC 3 Cross Section (E - E')
Vertical Extent of Uranium Contamination

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 11



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N

SWMUs

- Landfill I Beach Area
- Former "A", "B" and "C" Basin (closed)
- Gypsum Disposal Area
- Areas of Fill Deposition
- FUSRAP AOC Boundaries

0 145 290 580 Feet

Notes:
1. Source: DuPont Corporate Remediation Group, Drawing DWMI961001 rev 200 4/10/01
2. Aerial Photo taken in September 2005

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Locations of DuPont Solid Waste Management Units (SWMUs)

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 12

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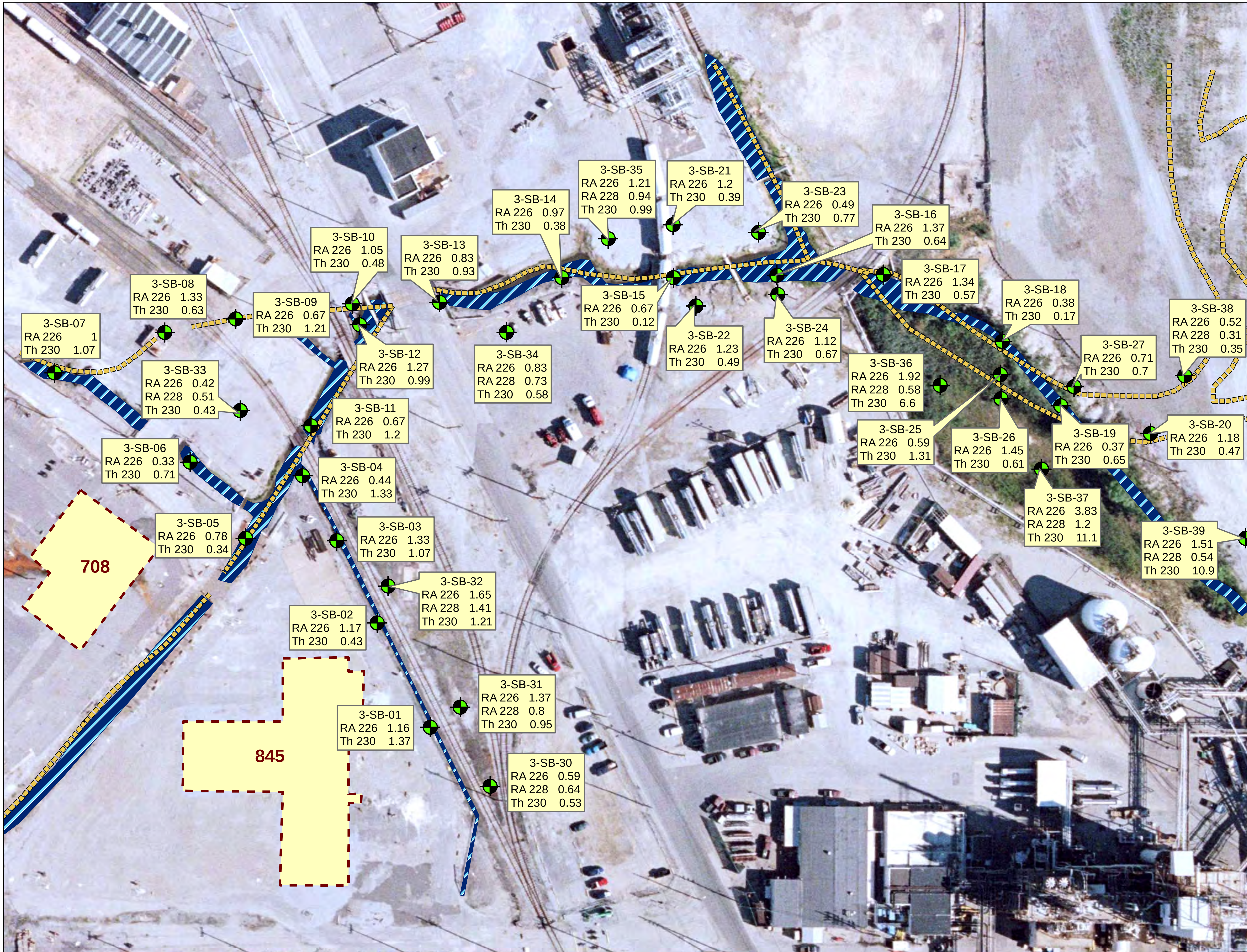

N

Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 50 100 200 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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AOC 3 Radiochemical Analysis in Soils

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
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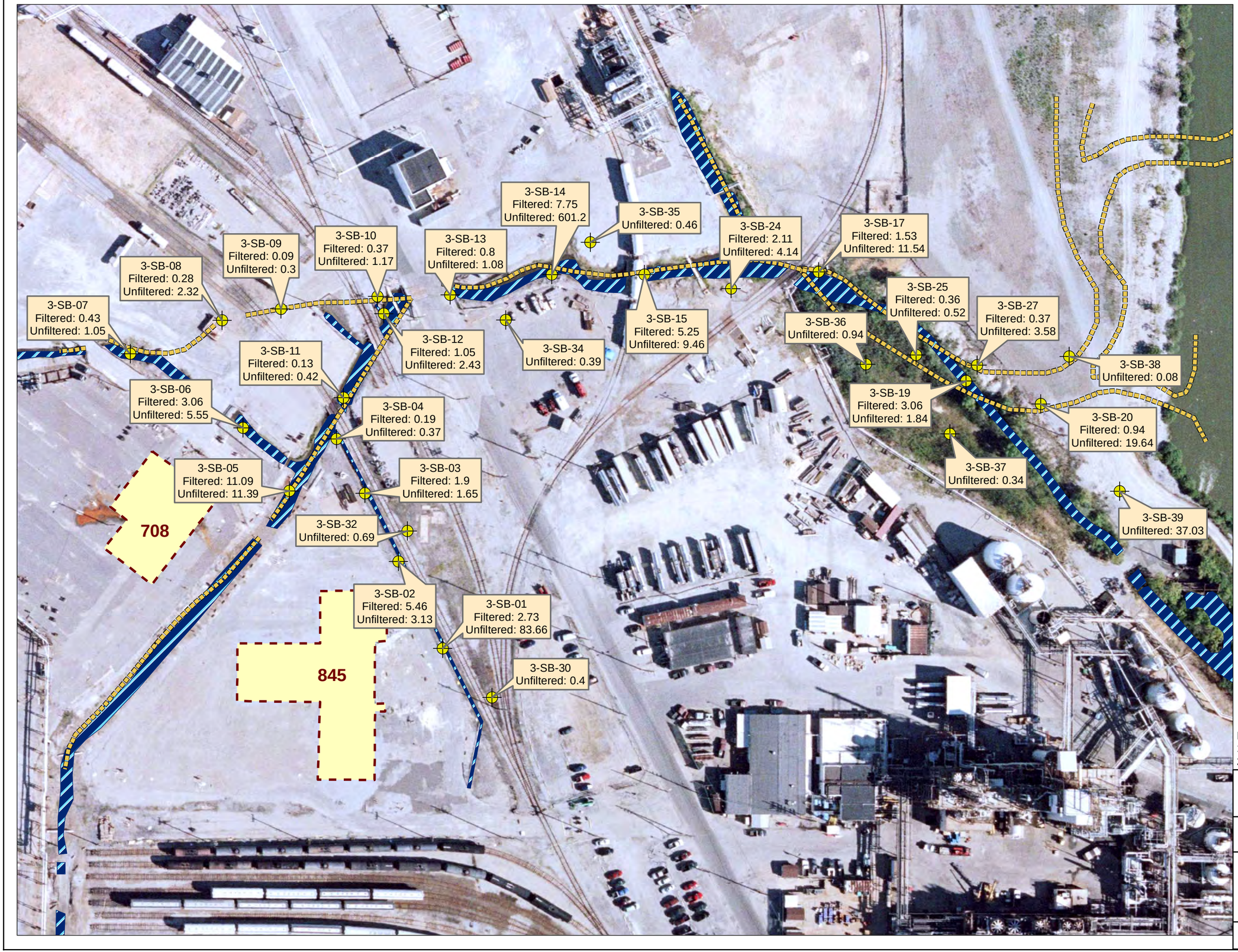
June 2011	Figure 5 - 13



031003

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DO NOT CITE OR QUOTE

3-SB-17 Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 50 100 200 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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AOC 3 Total Uranium in Groundwater Geoprobe Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
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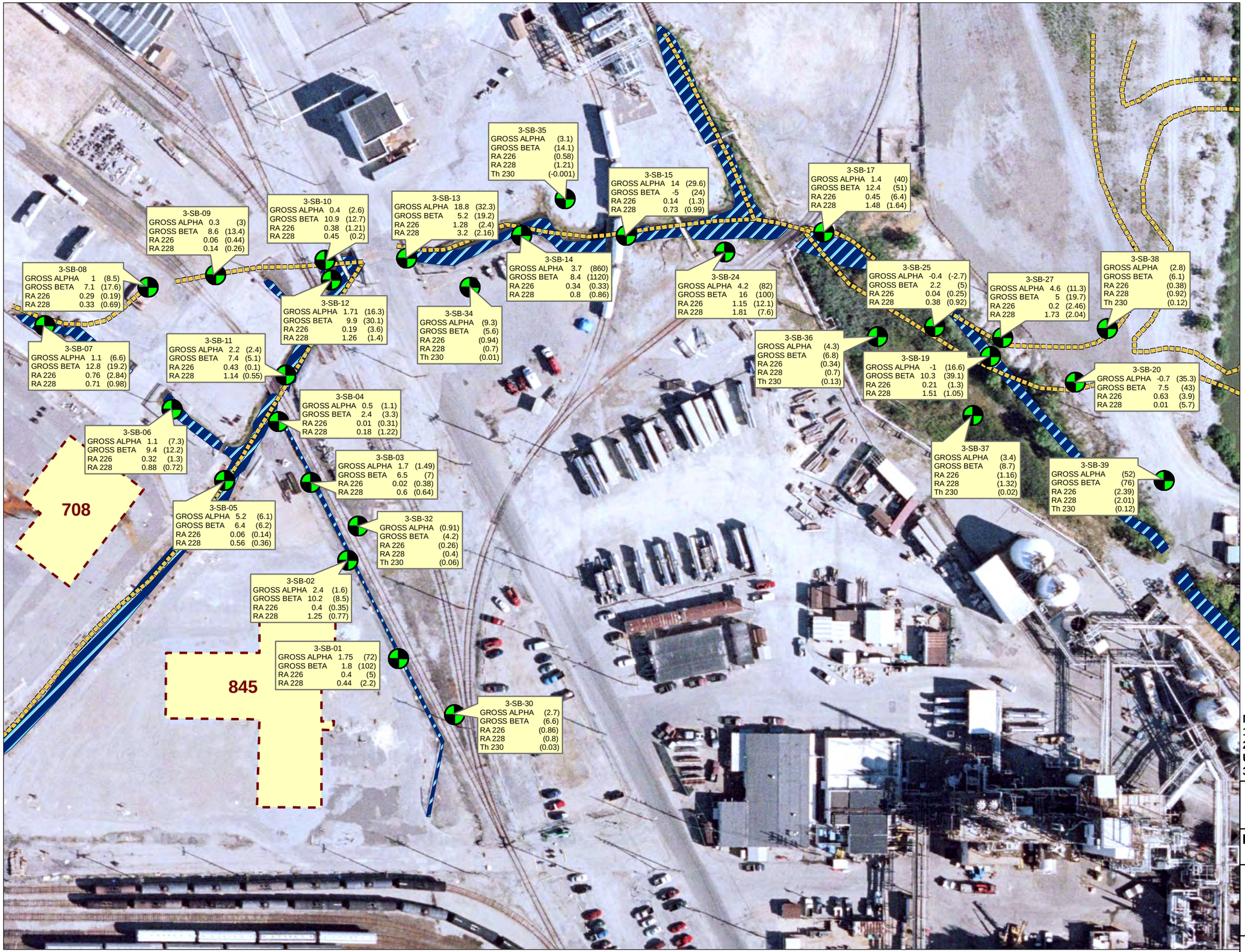
June 2011 | Figure 5 - 14



031003

FINAL

DO NOT CITE OR QUOTE

N

Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 50 100 200 Feet

Notes:
1. All results reported in picoCuries per liter (pCi/L)
2. Both Filtered and Unfiltered results are presented; Unfiltered results are shown in parenthesis.
3. Aerial Photo taken in September 2005

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Radiochemical Analysis of Groundwater Geoprobe Samples - AOC 3

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
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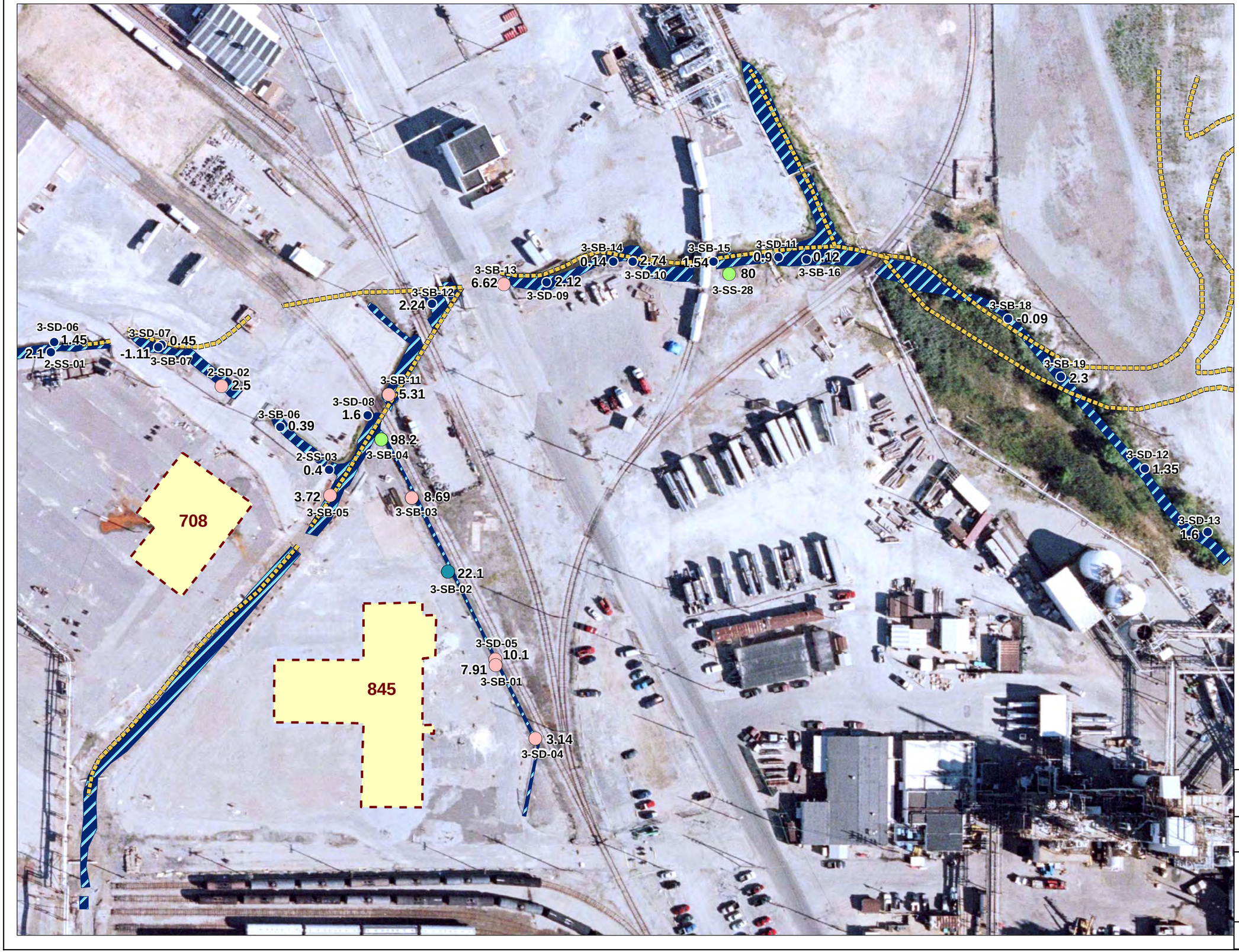
Deepwater, New Jersey

	June 2011	Figure 5 - 15



031003

FINAL

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Total Uranium Concentrations

- > 76
- 14 - 75
- 3 - 13
- < 3

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 50 100 200 Feet

Notes:

1. All results reported in picoCuries per gram (pCi/g)
2. The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location
3. Aerial Photo taken in September 2005

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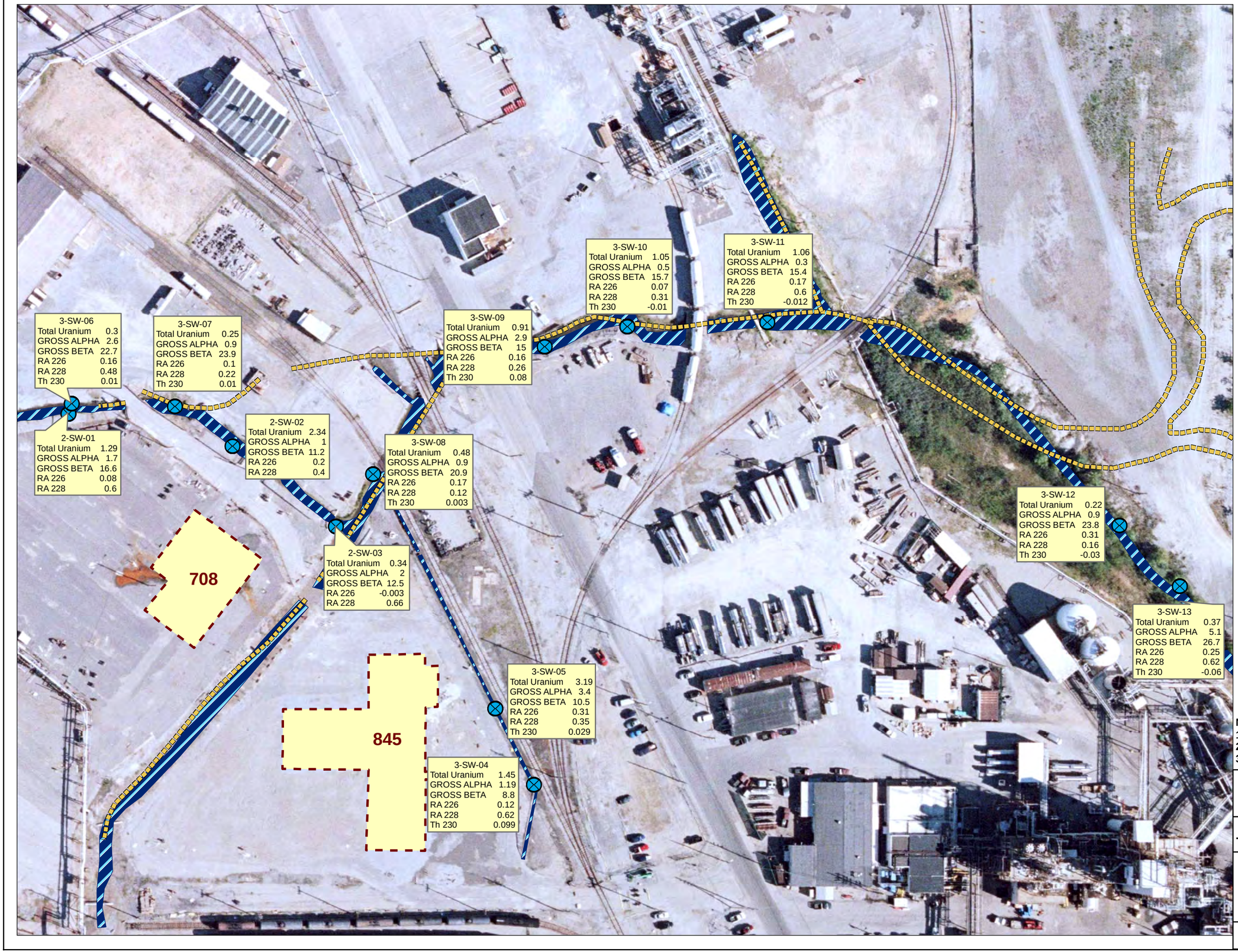
AOC 3 Total Uranium in Sediment Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 5 - 16



Surface Water Sample Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 50 100 200 Feet

Notes:

1. Total uranium results reported in micrograms per liter (ug/L)
2. All other results reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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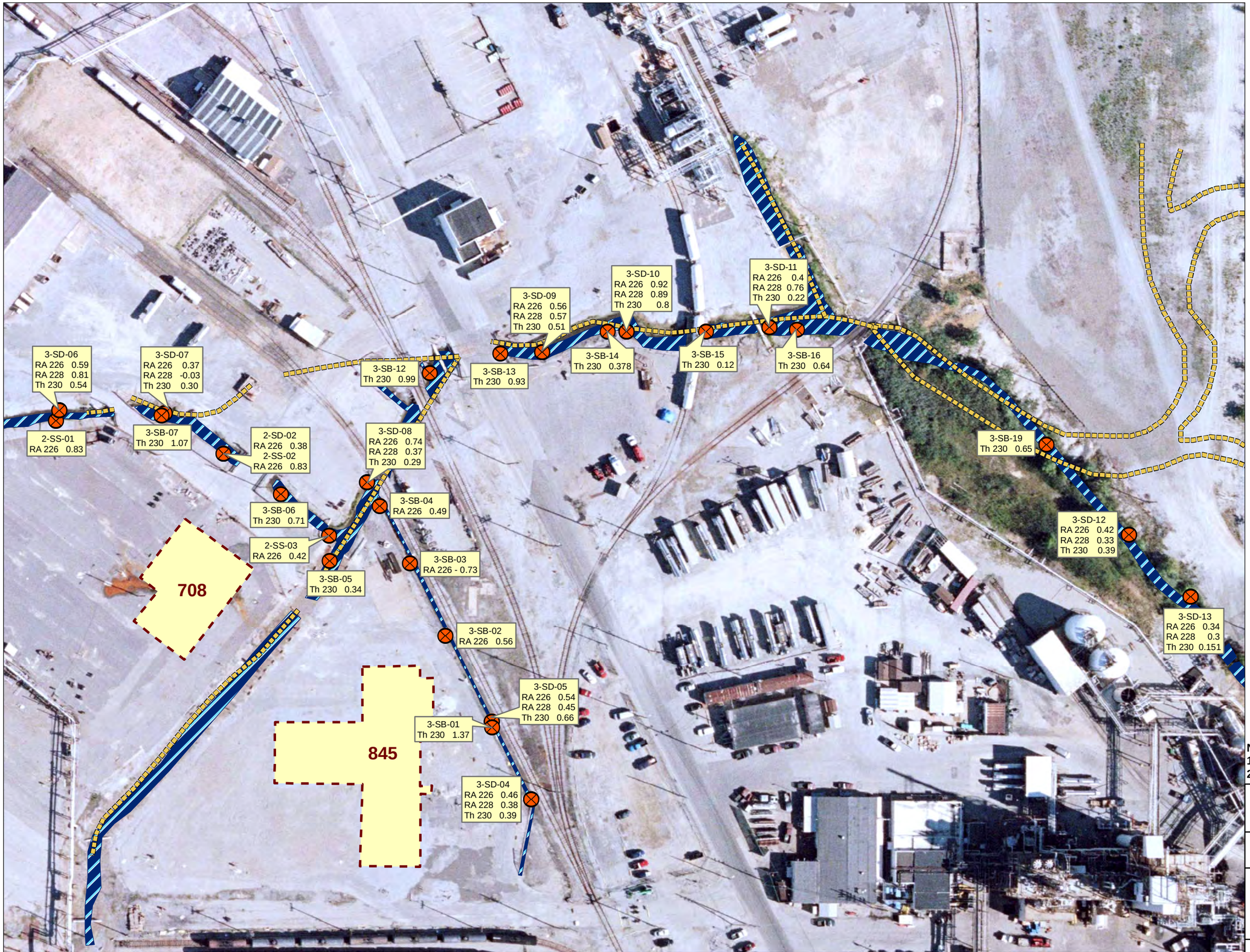
AOC 3 Radiochemical Analysis and Total Uranium of Surface Water Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 17



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Sediment Sample Location

Former Drainage Ditch Location

Former Buildings 845 and 708

Current Drainage Ditch Location

0 45 90 180 Feet

Notes:
1. All results reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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AOC 3 Radiochemical Analysis of Sediment Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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Total Uranium Concentrations

- 3 - 13
- < 3
- 5-SB-10 Sampling Station Location and ID
- Former Drainage Ditch Location
- Former Building J-16

0 20 40 80 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Uranium Total is followed by the (depth in feet) below ground surface
3. Aerial Photo taken in September 2005

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AOC 5 Total Uranium Concentrations in Soil Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	April 2009	Figure 5 - 19

Sample Station Location

Former Drainage Ditch Location

Former Building J-16

0 12.5 25 50 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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AOC 5 Radiochemical Analysis in Soils

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 20

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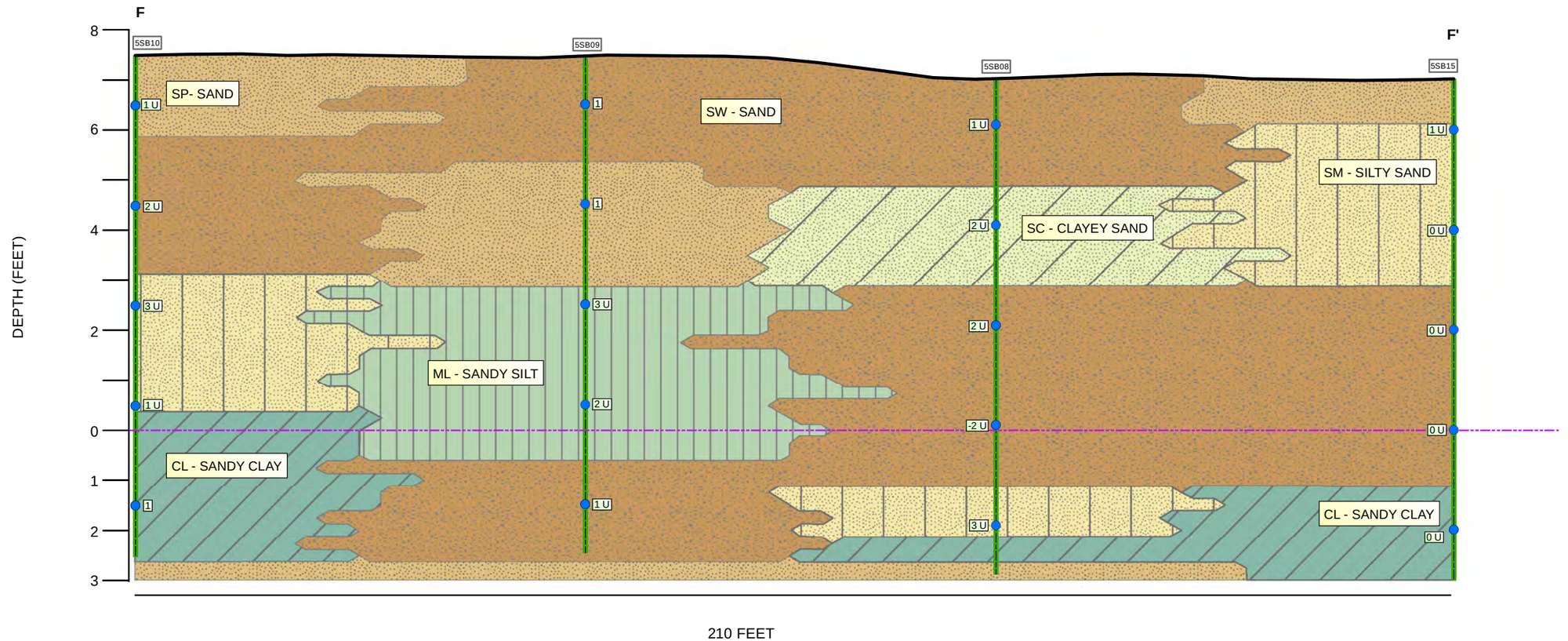

Cross Section (F - F')

Soil Boring

Drainage Ditch

Former Building

Sample Results

Uranium Total < 14.0 pCi/g

Uranium Total > 14.0 pCi/g

4 Sample Results (pCi/g)

Soil Classification

GW - Gravel (Well Graded)

GP - Gravel (Poorly Graded)

SW - Sand (Well Graded)

SP - Sand (Poorly Graded)

SM - Silty Sand

SC - Clayey Sand

ML - Sandy Silt

CL - Sandy Clay

MH - Silt

CH - Clay (High Plasticity)

VERTICAL EXAGGERATION = 15X

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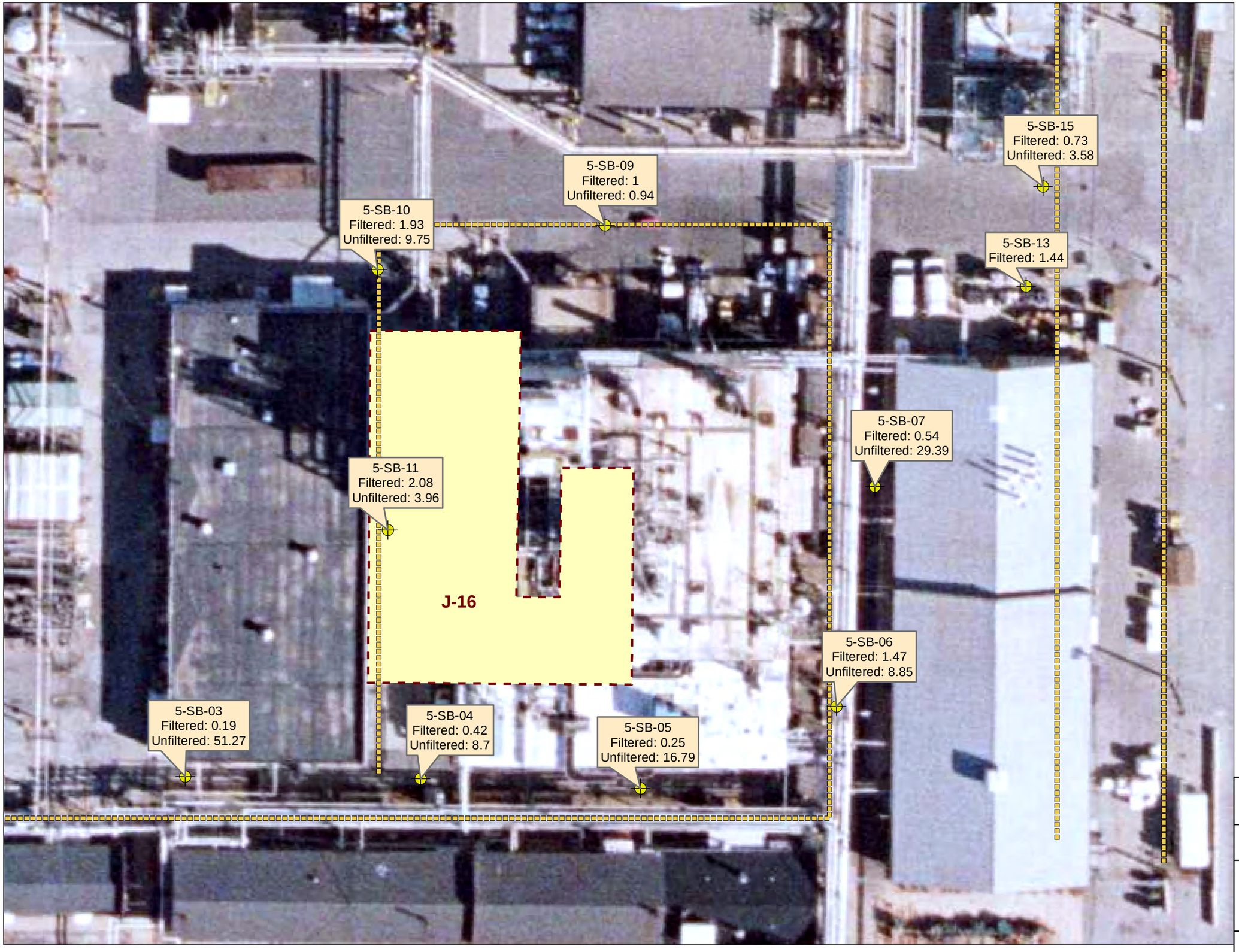
AOC 5 Cross Section (F - F')
Vertical Extent of Contamination

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 5 - 21**



N

5-SB-15 Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Building J-16

0 15 30 60 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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AOC 5 Total Uranium in Groundwater Geoprobe Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 5 - 22

N

5-SB-09		
GROSS ALPHA	3.6	(52)
GROSS BETA	11	(64)
RA 226	1.2	(8.1)
RA 228	2.27	(4.1)

5-SB-10		
GROSS ALPHA	5.5	(111)
GROSS BETA	12.9	(111)
RA 226	0.91	(15.2)
RA 228	1.33	(0.4)

5-SB-15		
GROSS ALPHA	0.89	(4.6)
GROSS BETA	4	(9.8)
RA 226	0.13	(2.8)
RA 228	0.58	(1.77)

5-SB-13	
GROSS ALPHA	0.59
GROSS BETA	9.6
RA 226	1.99
RA 228	0.49

J-16

5-SB-11		
GROSS ALPHA	1.6	(28.1)
GROSS BETA	14.5	(47.3)
RA 226	0.52	(3.06)
RA 228	0.75	(3.3)

5-SB-07		
GROSS ALPHA	0.8	(406)
GROSS BETA	21.2	(510)
RA 226	0.48	(27)
RA 228	1.01	(16)

5-SB-06		
GROSS ALPHA	0.57	(51)
GROSS BETA	17.4	(80)
RA 226	0.24	(10.5)
RA 228	1.34	(5.5)

5-SB-03		
GROSS ALPHA	0.56	(14.4)
GROSS BETA	8.8	(29.5)
RA 226	0.17	(8.5)
RA 228	0.95	(1.7)

5-SB-04		
GROSS ALPHA	0.13	(12.4)
GROSS BETA	9.8	(27)
RA 226	0.02	(1.71)
RA 228	0.28	(3.5)

5-SB-05		
GROSS ALPHA	0.43	(41.7)
GROSS BETA	9.2	(69)
RA 226	0.16	(6.6)
RA 228	0.67	(2.2)

Geoprobe Sample Station Location

Former Drainage Ditch Location

Former Building J-16

0 15 30 60 Feet

Notes:
1. All results reported in picoCuries per liter (pCi/L)
2. Both Filtered and Unfiltered results are presented; Unfiltered results are shown in parenthesis.
3. Aerial Photo taken in September 2005

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AOC 5 Radiochemical Analysis of Groundwater Geoprobe Samples

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

FINAL

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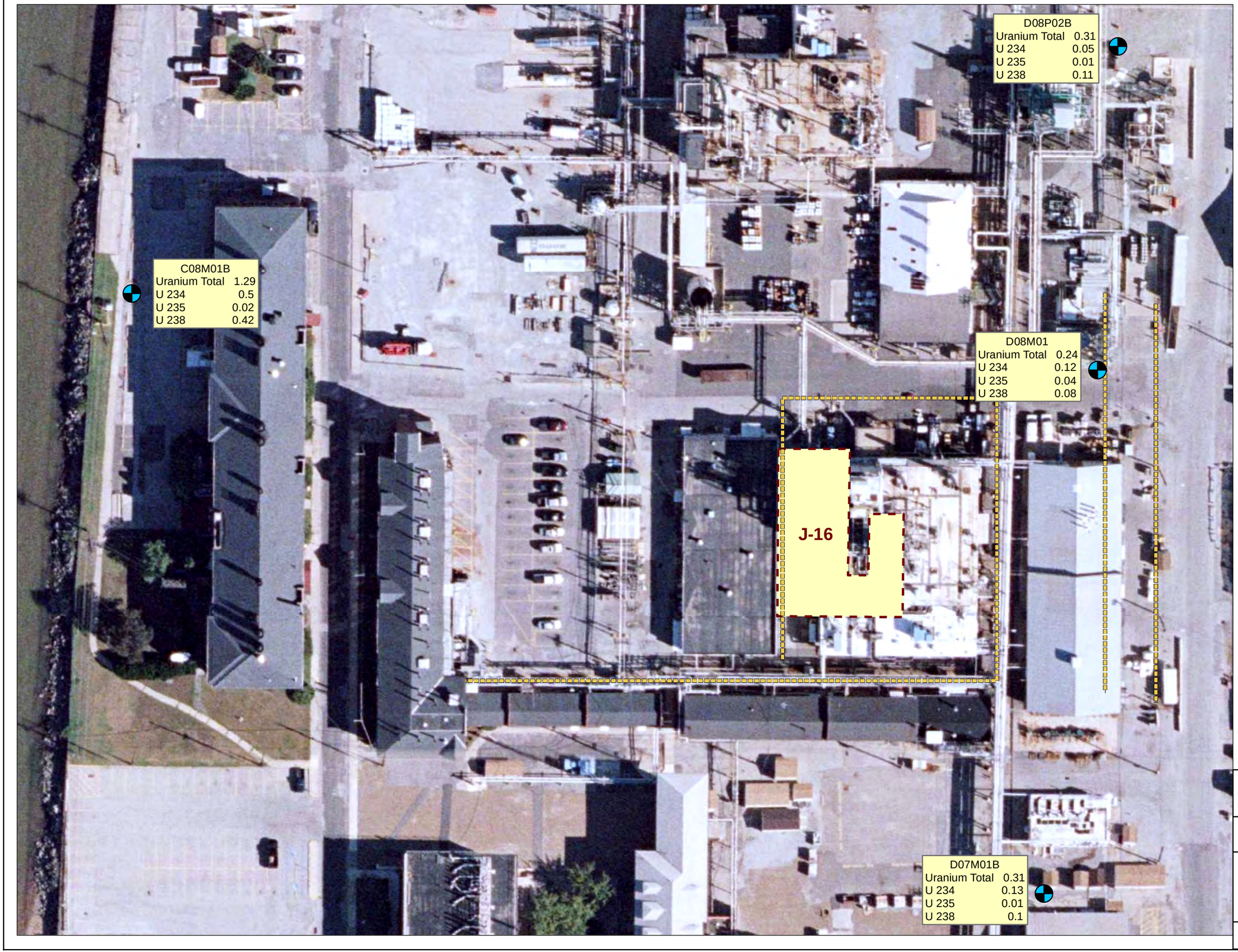

N

Monitoring Well Location

Former Drainage Ditch Location

Former Building J-16

0 30 60 120 Feet

Notes:
1. Uranium Total results are reported in micrograms per liter (ug/L)
2. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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AOC 5 Average Total Uranium and Isotopic Results in Monitoring Wells

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USACE- FUSRAP
DuPont Chambers Works
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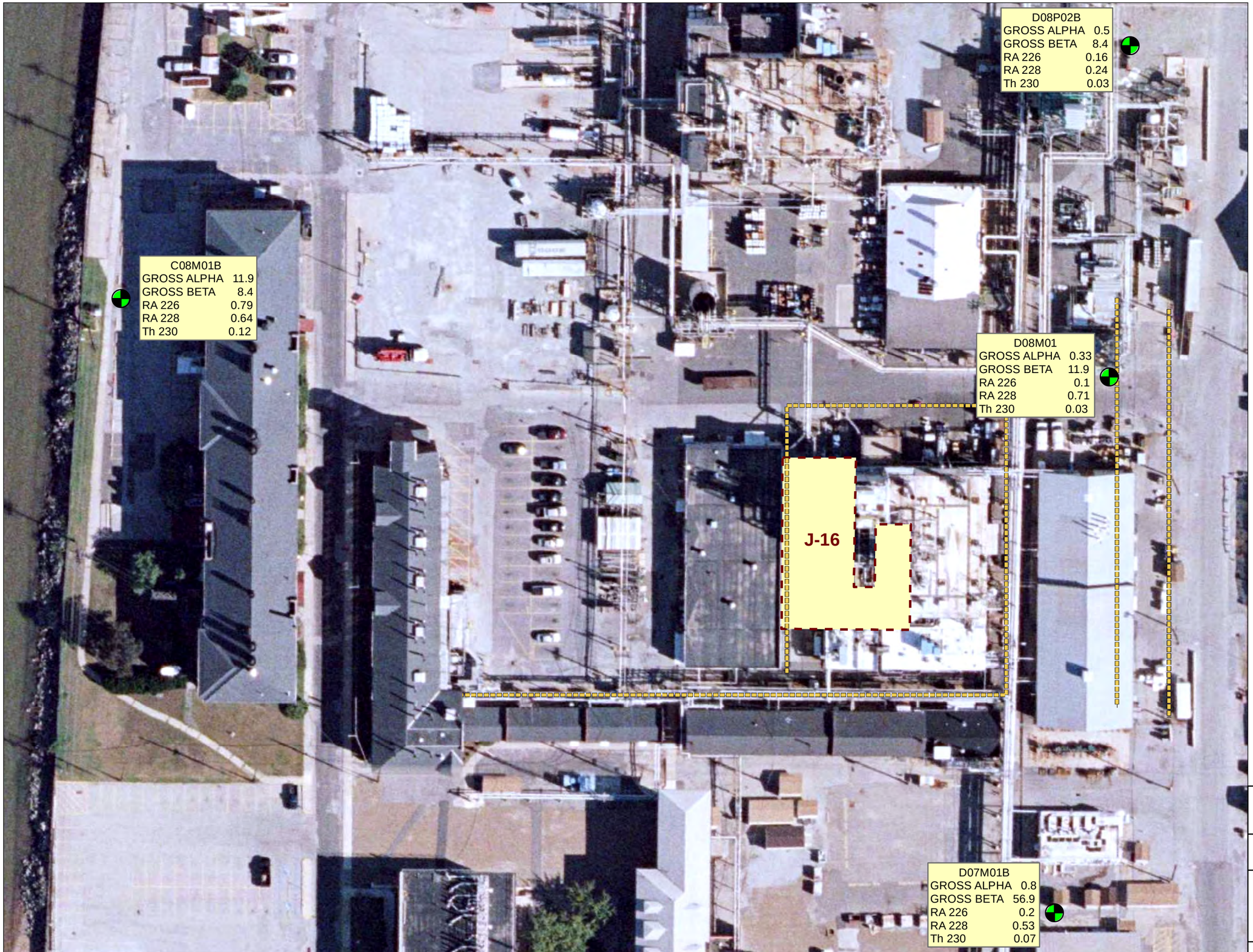
June 2011 | Figure 5 - 24



N

Monitoring Well Location

Former Drainage Ditch Location

Former Building J-16

0 30 60 120 Feet

Notes:
1. All results are reported in picoCuries per liter (pCi/L)
2. Aerial Photo taken in September 2005

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AOC 5 Radiochemical Analysis Results in Monitoring Wells

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N

4CPT63 4CPT62 4CPT46 4CPT47 4CPT49 4CPT50 4CPT48 4CPT51 4CPT52 4CPT53 4CPT54 4CPT55 4CPT56 4CPT57 4CPT58 4CPT59

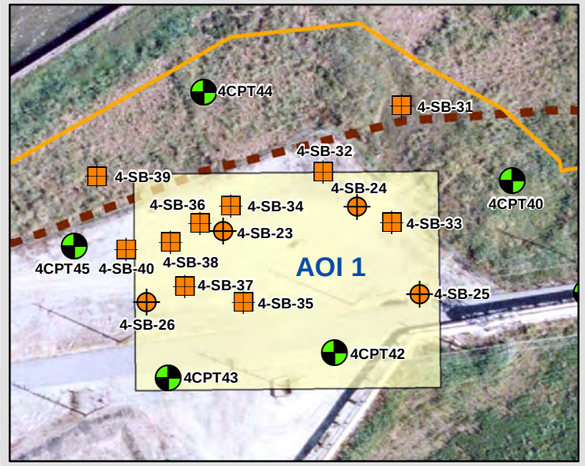
4CPT39 4CPT37 4CPT38 4CPT41 4CPT36 4CPT35 4CPT34 4CPT11 4CPT13 4CPT33 4CPT10 4CPT32 4-SB-28 4-SB-30 4CPT31 4CPT61 4-SB-29 4-SB-27 4CPT30 4CPT22 4CPT12 4CPT09 4CPT08 4CPT07 4CPT06 4CPT05 4CPT04 4CPT03 4CPT15 4CPT16 4CPT01 4CPT14 4CPT02

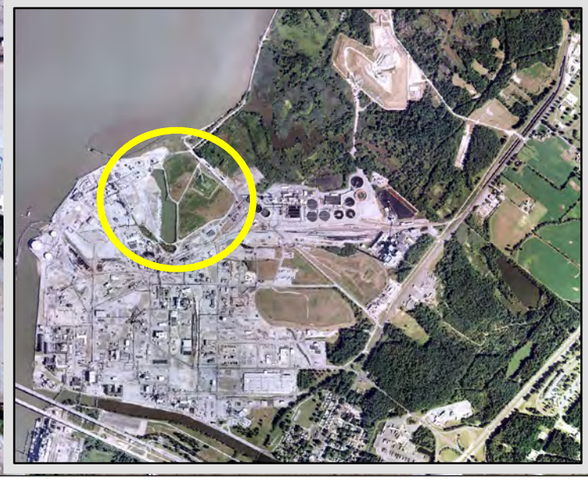
A Basin Cap

AOI 2

4CPT21 4CPT23 4CPT24 4CPT20 4CPT29 4CPT25 4CPT19 4CPT28 4CPT17 4CPT18 4CPT26 4CPT27

Basin B





Additional 2007 Soil Boring Locations

Soil Boring Locations

CPT Locations

Areas of Interest 1 & 2

AOC 4 Boundary

Former Lagoon Area

0 135 270 540 Feet

Note: Aerial Photo taken in September 2005

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AOC 4 CPT and Soil Boring locations

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June 2011 | Figure 6 - 1

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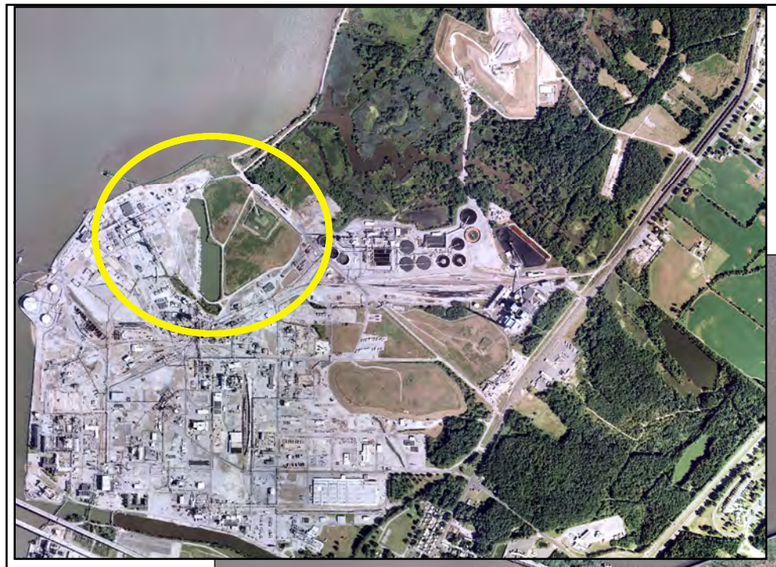

FINAL
DO NOT CITE OR QUOTE

Former Lagoon Area

Areas of Interest (AOIs) 1 & 2

AOC 4 Boundary

AOCs 1, 2 & 3 Boundary

0 1,150 2,300 4,600 Feet

Note: Aerial Photo taken in September 2005

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Areas of Interest
AOC 4 - Historical Lagoon

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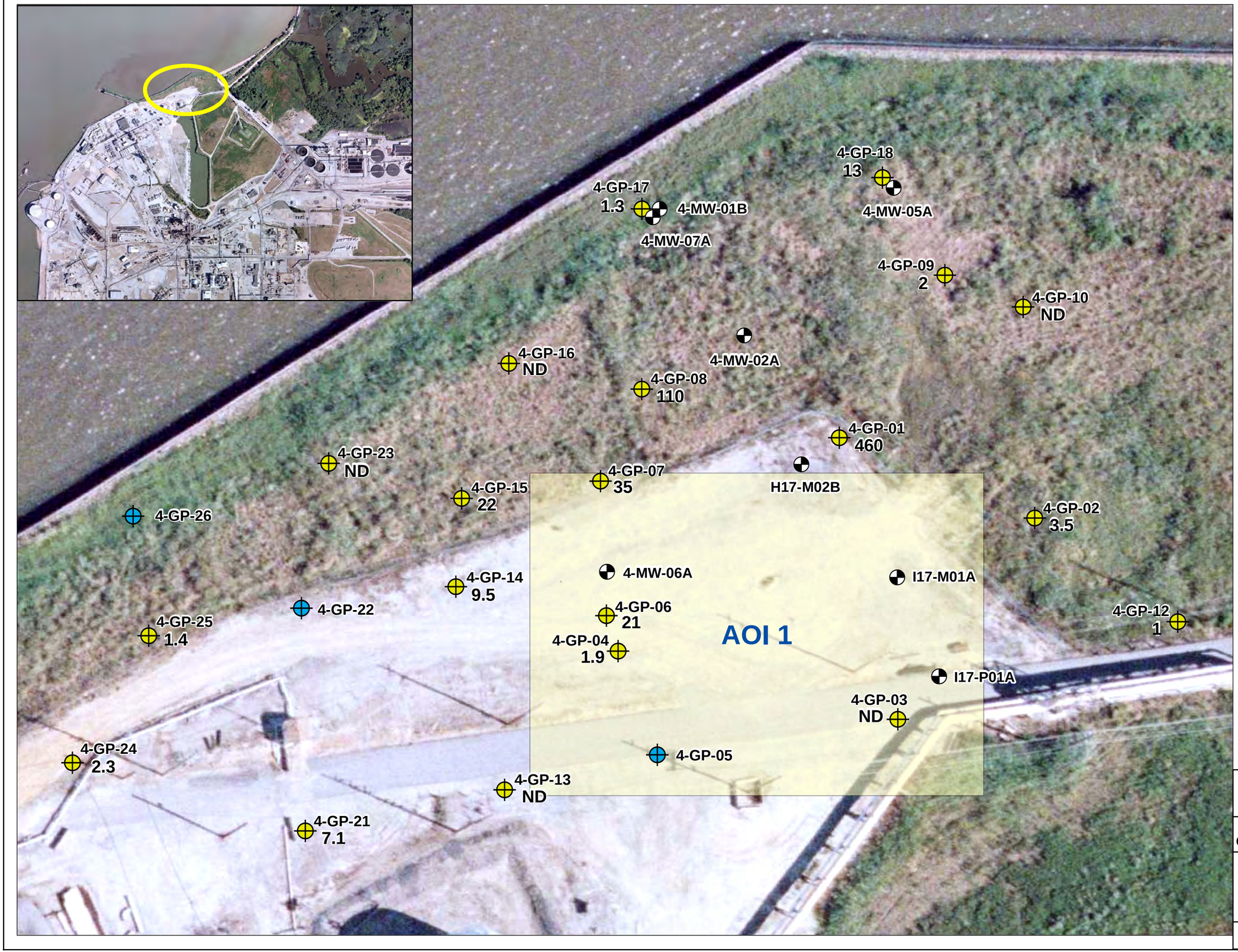
June 2011 | **Figure 6 - 3**



031003

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Geoprobe Sample

- Proposed geoprobe point not performed
- Geoprobe groundwater sample location
- Well Locations
- Area of Interest (AOI) 1

0 25 50 100 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. ND - Not Detected
3. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Groundwater Geoprobe Samples - AOC 4

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DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 4

N

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Well Locations

AOC 4 Boundary

0 25 50 100 Feet

Note: Aerial Photo taken in September 2005

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Monitoring Well Locations, AOC 4

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Deepwater, New Jersey

	June 2011	Figure 6 - 5

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N

6CPT09
6CPT10
6CPT12
6CPT08
AOI 2
6CPT11
6CPT06
6CPT07
6CPT16
6CPT14
6CPT15
6CPT34
6CPT03
AOI 3
6CPT04
6CPT05
6CPT01
6CPT13
6CPT17
6CPT02
AOI 1
6CPT18
6CPT63
6CPT35
6CPT19
6CPT62
6CPT64
6CPT62A
6CPT20
AOI 4
6CPT22
6CPT24
6CPT28
6CPT21
6CPT23
6CPT29
6CPT27
6CPT26
6CPT25
6CPT39
6CPT66
6CPT40
6CPT36
6CPT37
6CPT38
6CPT43
6CPT47
6CPT45
6CPT41
AOI 6
6CPT65
6CPT44
6CPT42
6CPT46
6CPT51
6CPT58
6CPT49
6CPT52
AOI 7
6CPT50
6CPT30
6CPT60
6CPT31
6CPT33
6CPT53
6CPT32
6CPT61
AOI 5
6CPT59
6CPT54
6CPT56
6CPT55
6CPT57

CPT Locations

Areas of Interest

AOC 6 Boundary

0 70 140 280 Feet

Note: Aerial Photo taken in September 2005

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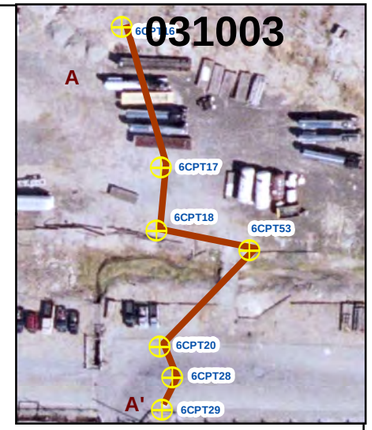
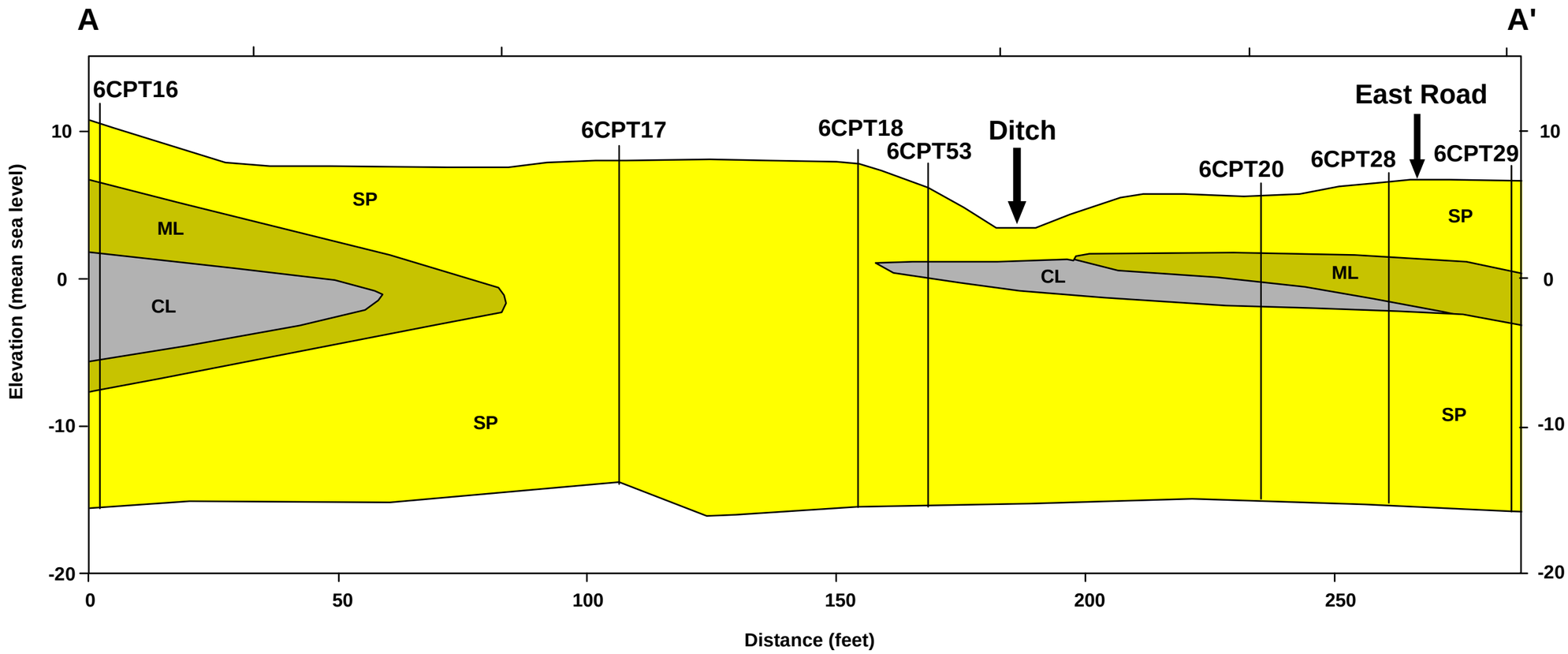
CPT Locations, AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 6





Note: Aerial Photo taken in September 2005

CL (Clays)

SP (Poorly Graded Sands)

ML (Well-Graded Sands)

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Geologic Cross Section, AOC 6

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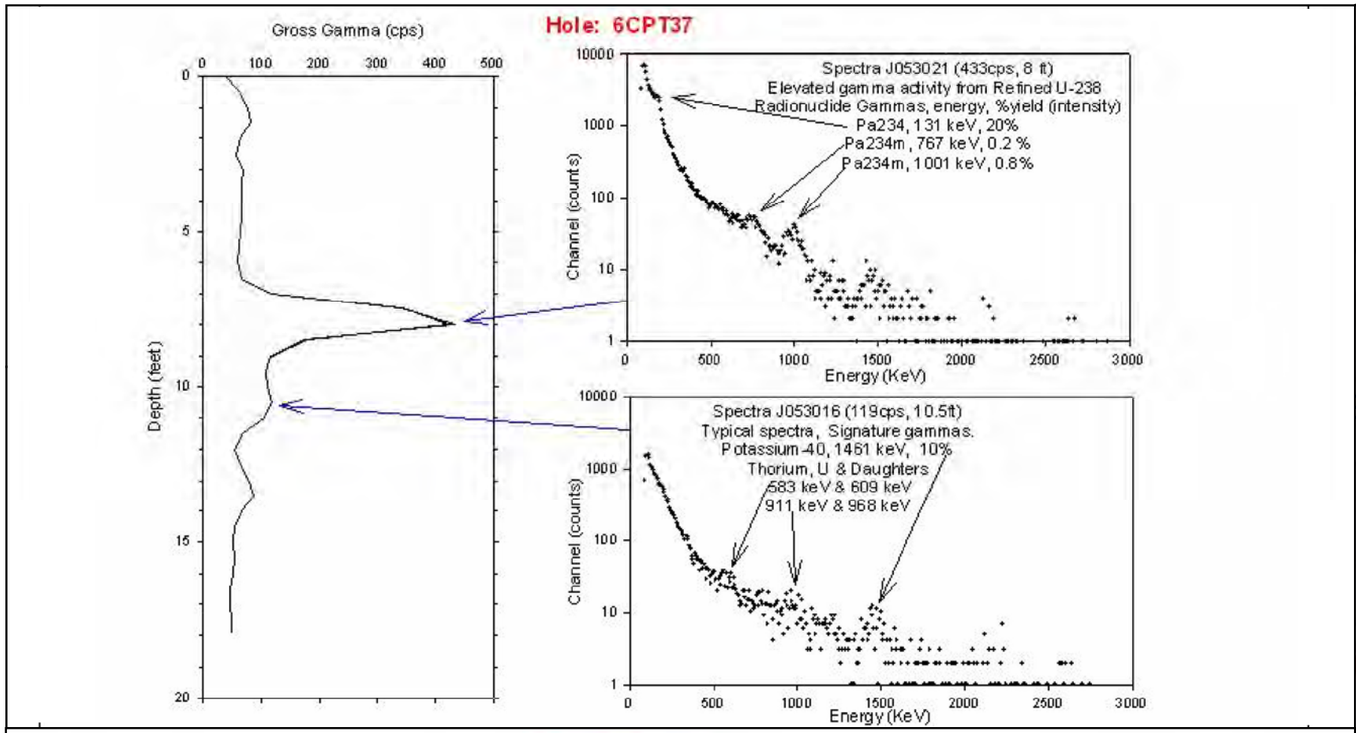
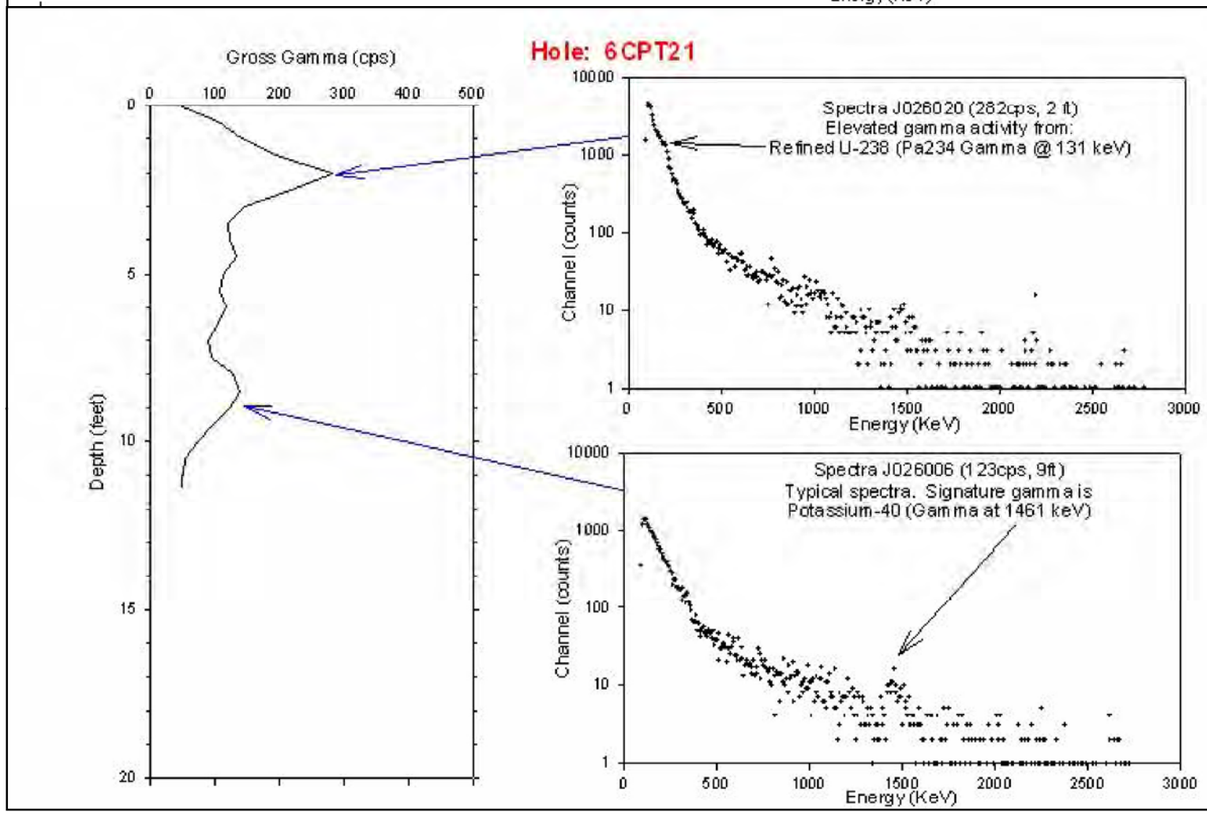
June 2011 | Figure 6 - 7





Note: Aerial Photo taken in September 2005

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Gamma Spectral Data
6CPT21 and 6CPT37

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 8

031003

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N

6-SB-22
6-SB-21
6-CPT-37
6-SB-20
6-SB-19
6-CPT-45
6-SD-01
6-SD-03
6-CPT-25
6-CPT-54
6-MW-05B
6-SB-17A
6-SB-18A
6-SD-04
6-SB-41
6-MW-06B
6-SD-05
6-SB-40
6-SB-17
6-SB-18
6-SD-08
6-SD-11
6-SD-07
6-SD-09
6-SD-06
6-SD-10
6-SD-12
6-SD-13
6-CPT-62A
6-SB-12
6-SB-13
6-SB-14
6-SB-15
6-SB-16
6-MW-07B
6-MW-01B
6-SB-31
6-MW-02B
6-SB-37
6-CPT-21
6-SB-39
6-SB-36
6-SB-32
6-SB-01
6-SB-38
6-SB-03
6-SB-04
6-SB-05
6-SB-06
6-SB-02
6-SB-35
6-SB-34
6-SB-33
6-SB-07
6-SB-09
6-SB-11
6-SB-08
6-SB-10
6-MW-04B
6-MW-03B

Additional 2007 Soil Sample Locations

Sediment Locations

Soil Sample Locations

Area of Interest 4

AOC 6 Boundary

0 35 70 140 Feet

Note: Aerial Photo taken in September 2005

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Sediment and Soil Boring Locations in AOC 6

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Deepwater, New Jersey

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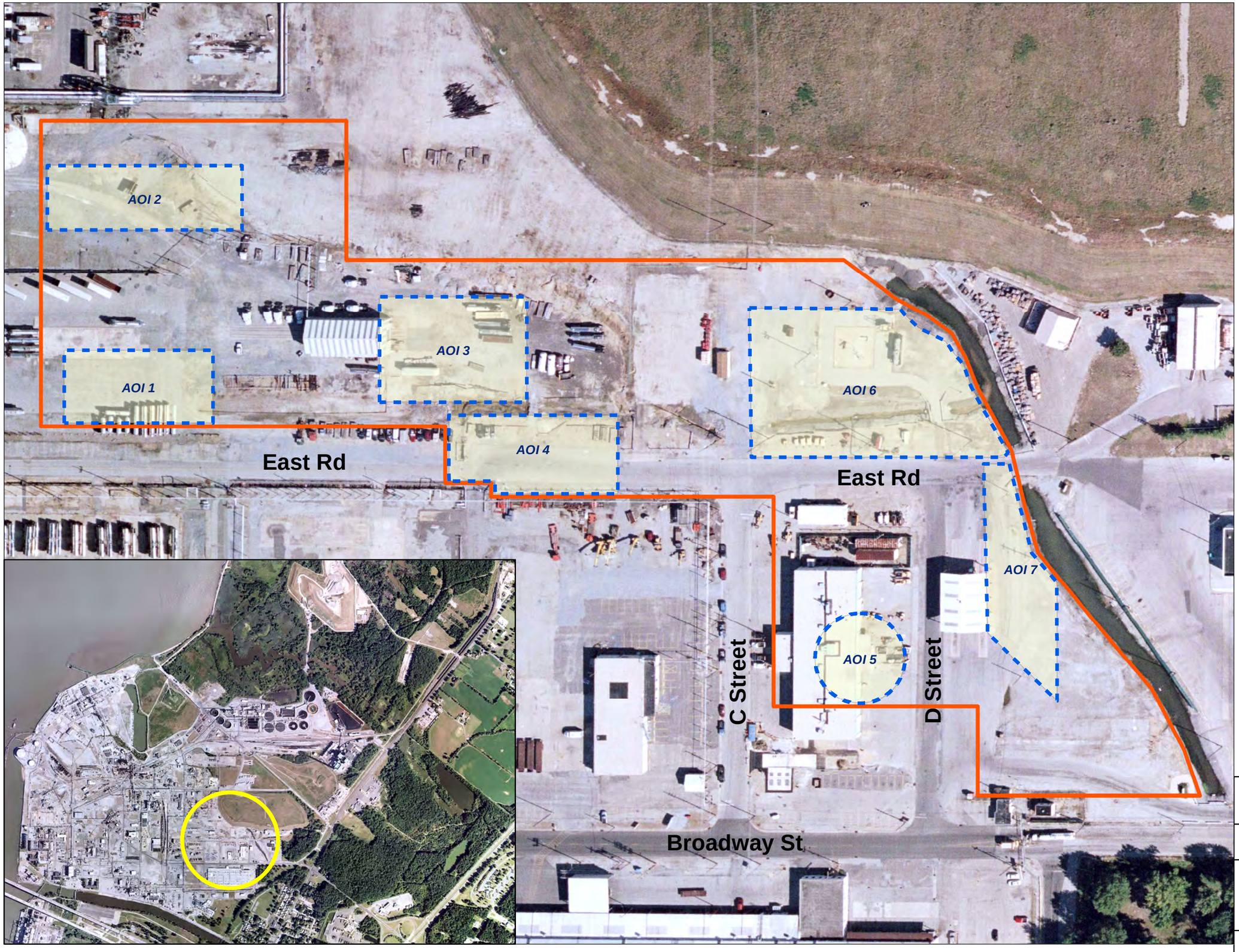

Boundary of AOC 6

Area of Interest in AOC 6

0 65 130 260 Feet

Note: Aerial Photo taken in September 2005

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Areas of Interest in AOC 6 - East Area

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DuPont Chambers Works
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AOI 3

6-GP-02
ND
6-MW-05B

6-GP-03
14
6-MW-06B

6-GP-04
ND
6-MW-01B

6-MW-07B

6-MW-02B

AOI 4

6-GP-01
3.5
6-MW-04B

6-MW-03B

Geoprobe groundwater sample location

Well Locations

Areas of Interest (AOI) 3 and 4

0 15 30 60 Feet

Notes:
1. All results reported in micrograms per liter (ug/L)
2. ND - Not Detected
3. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Groundwater Geoprobe Samples - AOC 6

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USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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SB Locations

CPT Locations

1 m Contour of Z-Score

- <1
- 1-2
- 2-3
- >3

0 1,600 3,200 6,400 Feet

Note: Aerial Photo taken in September 2005

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AOC 4
Gamma Walkover Survey Results

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DuPont Chambers Works
Deepwater, New Jersey

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Total Uranium Concentration in pCi/g and (depth in feet) below ground surface

- > 158
- 76 - 158
- 14 - 75
- 3 - 13
- < 3
- 4-CPT-24 Sample Station Location and ID

0 110 220 440 Feet

Notes:
1. The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location.
2. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Soil Samples for AOC 4

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 6 - 13

031003

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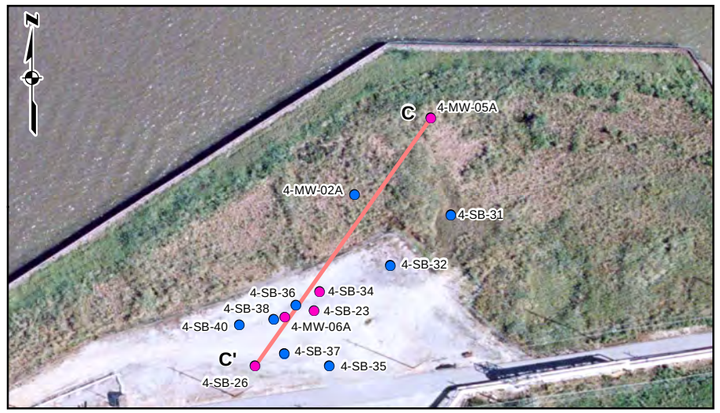
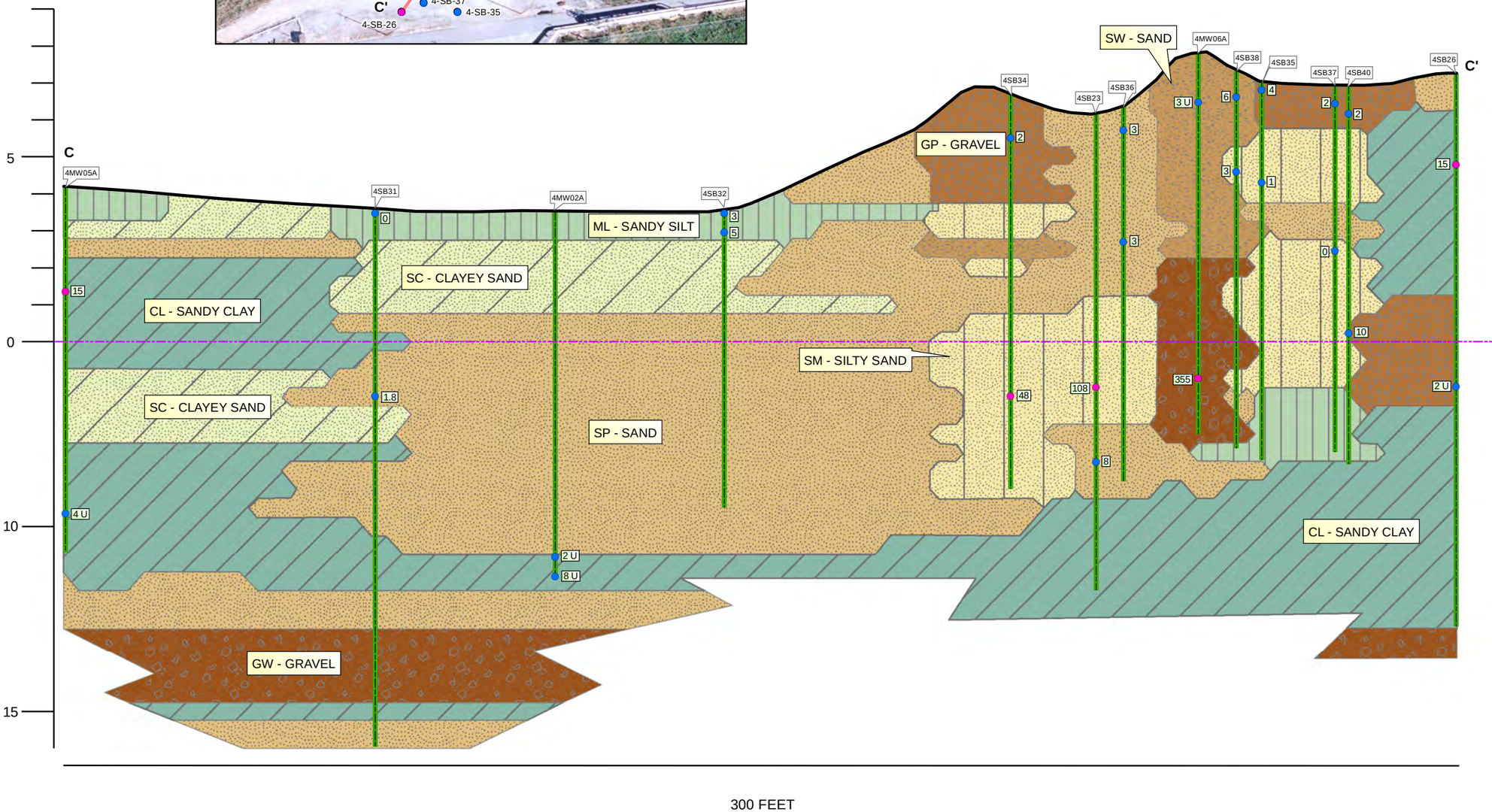
DO NOT CITE OR QUOTE





Cross Section (C - C')

Soil Boring

Sample Results

- Uranium Total > 14.0 pCi/g
- Uranium Total > 14.0 pCi/g
- 4 Sample Result (pCi/g)

Soil Classification

- GW - Gravel (Well Graded)
- GP - Gravel (Poorly Graded)
- SW - Sand (Well Graded)
- SP - Sand (Poorly Graded)
- SM - Silty Sand
- SC - Clayey Sand
- ML - Sandy Silt
- CL - Sandy Clay
- MH - Silt
- CH - Clay (High Plasticity)

VERTICAL EXAGGERATION = 8X

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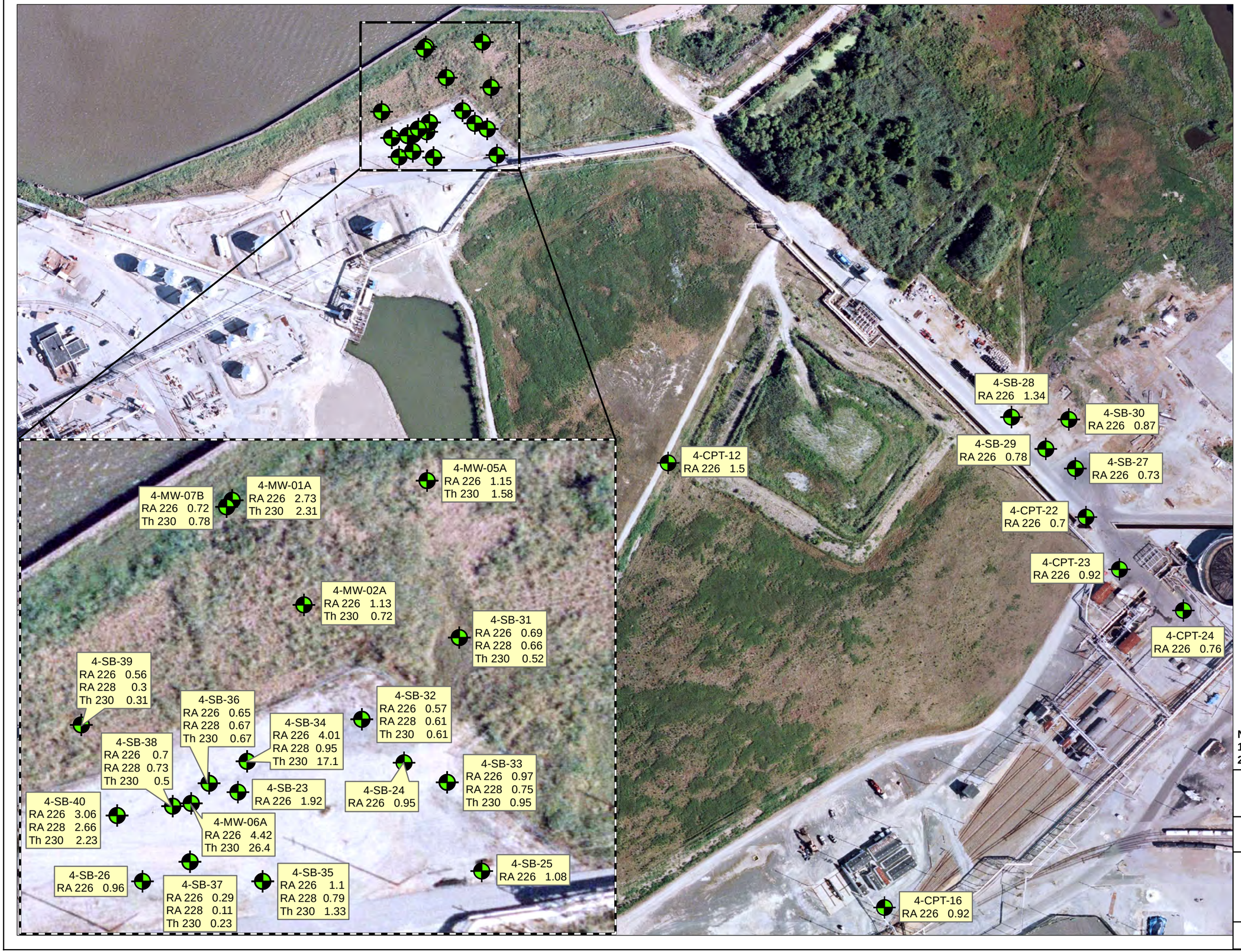
AOC 4 Cross Section (C - C')
Vertical Extent of Uranium Contamination

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 6 - 14



Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis in Soils for AOC 4

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 15

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Aquifer "A" Well

4.48 Groundwater Elevation Ft NAVD 88

Groundwater Elevation Contour
Contour Interval 0.5 Foot

(Arrow indicates Groundwater Flow Direction)

0 15 30 60 Feet

Note: Aerial Photo taken in September 2005

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Groundwater Elevation "A" Aquifer AOC 4 - Quarter 5 (Sept 2006)

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USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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N

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Aquifer "B" Well

0.67 Groundwater Elevation
Ft NAVD 88

Groundwater Elevation Contour
Contour Interval 1 Foot

(Arrow indicates Groundwater Flow Direction)

2

0 20 40 80 Feet

Note: Aerial Photo taken in September 2005

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Groundwater Elevation
"B" Aquifer AOC 4 - Quarter 5 (Sept 2006)

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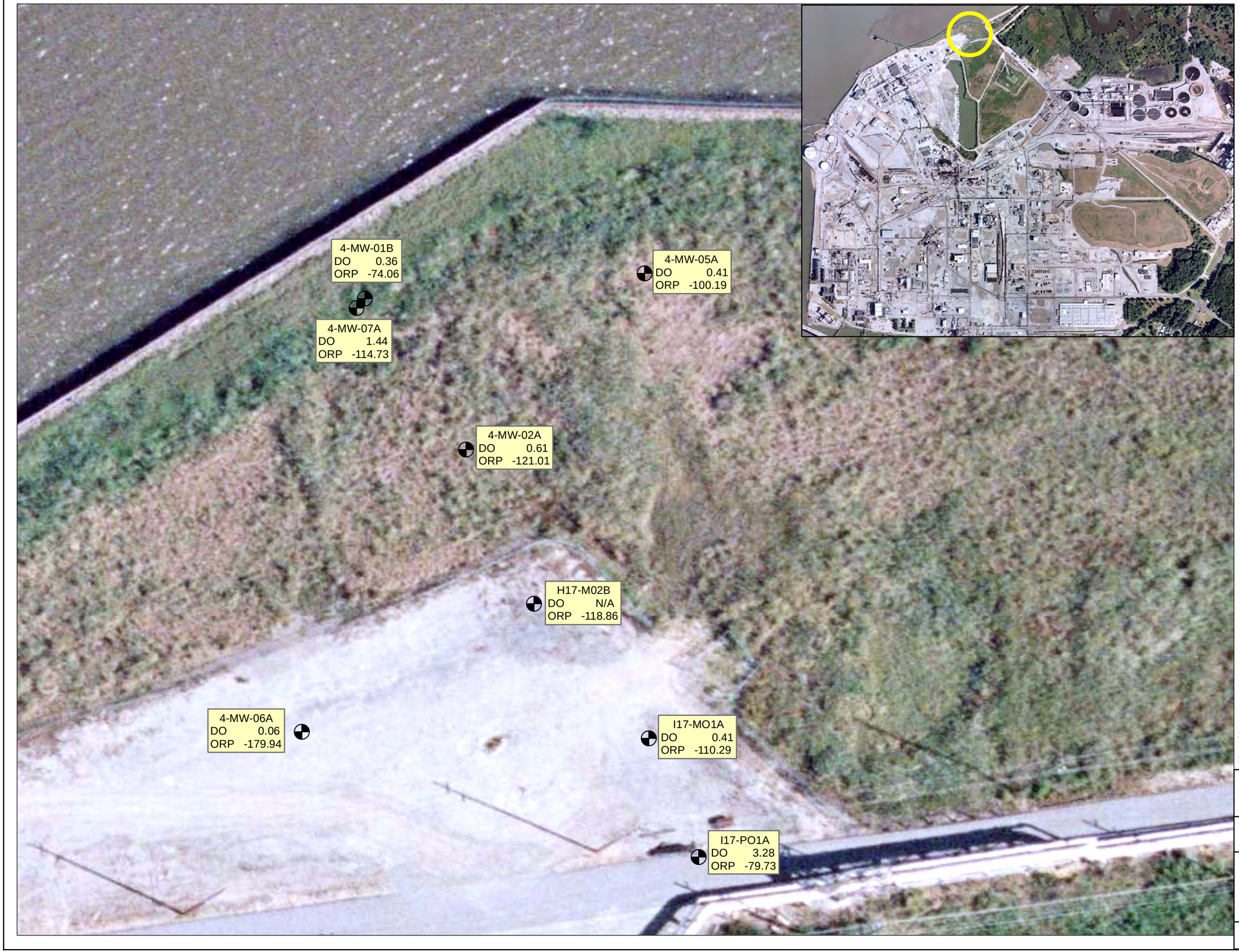
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 17



N

031003

FINAL

DO NOT CITE OR QUOTE

Sample Station Location

0 20 40 80 Feet

Notes:
1. Dissolved Oxygen (DO) is reported in ug/L
2. Oxygen Reduction Potential (ORP) is reported in millivolts
3. Aerial Photo taken in September 2005

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Average DO and ORP Values in Groundwater for AOC 4

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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4-MW-07A	
Uranium Total	0.35
U 234	0.13
U 235	0.02
U 238	0.09

4-MW-05A	
Uranium Total	4.24
U 234	1.38
U 235	0.08
U 238	1.38

4-MW-02A	
Uranium Total	11.39
U 234	3.77
U 235	0.21
U 238	3.72

4-MW-06A	
Uranium Total	22.23
U 234	8.98
U 235	0.32
U 238	7.25

I17-M01A	
Uranium Total	145
U 234	46.3
U 235	2.96
U 238	47.23

I17-P01A	
Uranium Total	0.28
U 234	0.13
U 235	0.03
U 238	0.09

N

Groundwater Flow Direction

Monitoring Well Location with total uranium results above 30 micrograms per liter (ug/L)

Monitoring Well Location

0 20 40 80 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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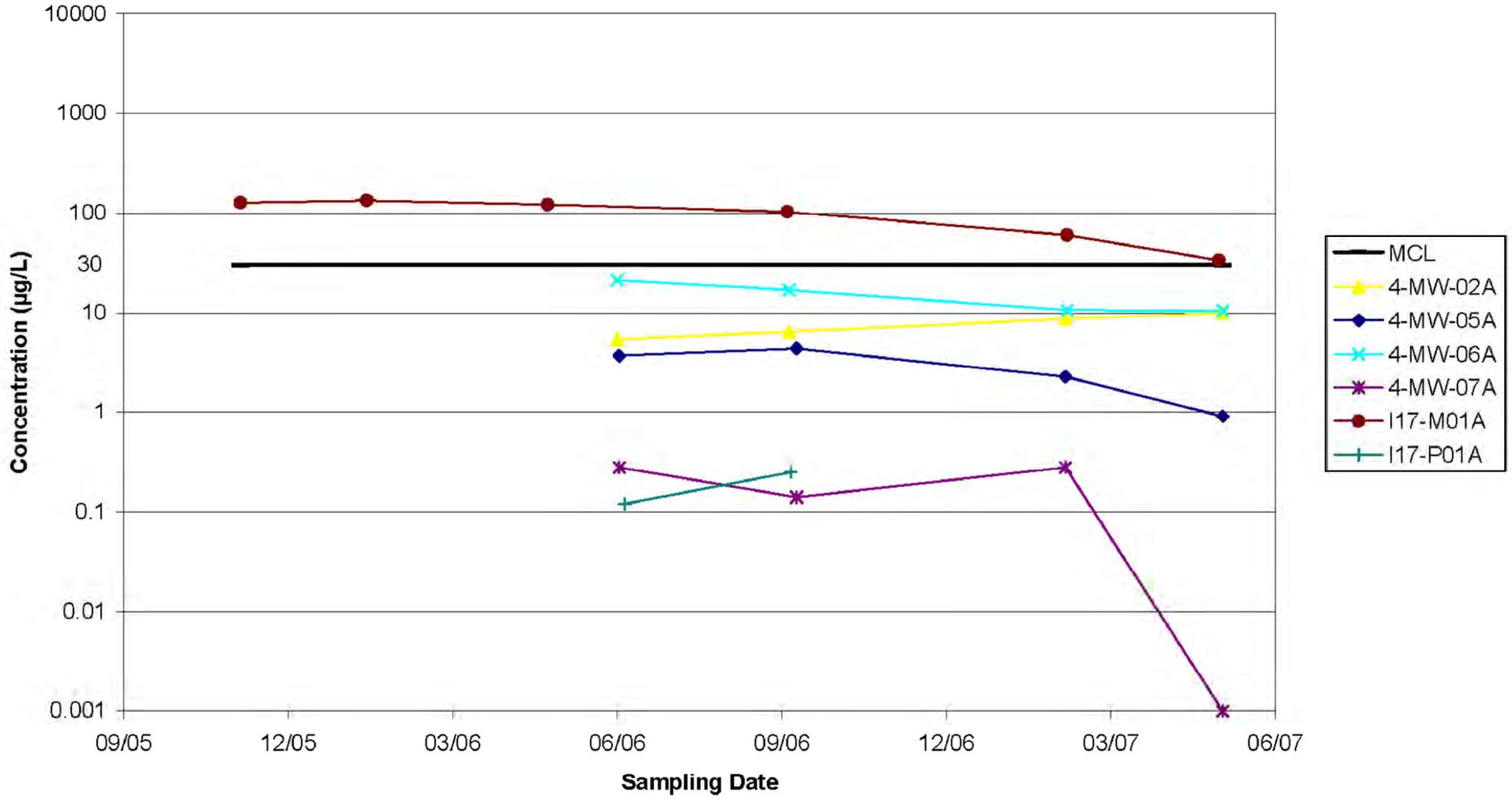
Average Isotopic and Total Uranium for AOC 4 - "A" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 19**

Total U Concentrations in Unfiltered Groundwater
Operable Unit 3, Area of Concern 4, Aquifer A
DuPont Chambers Works



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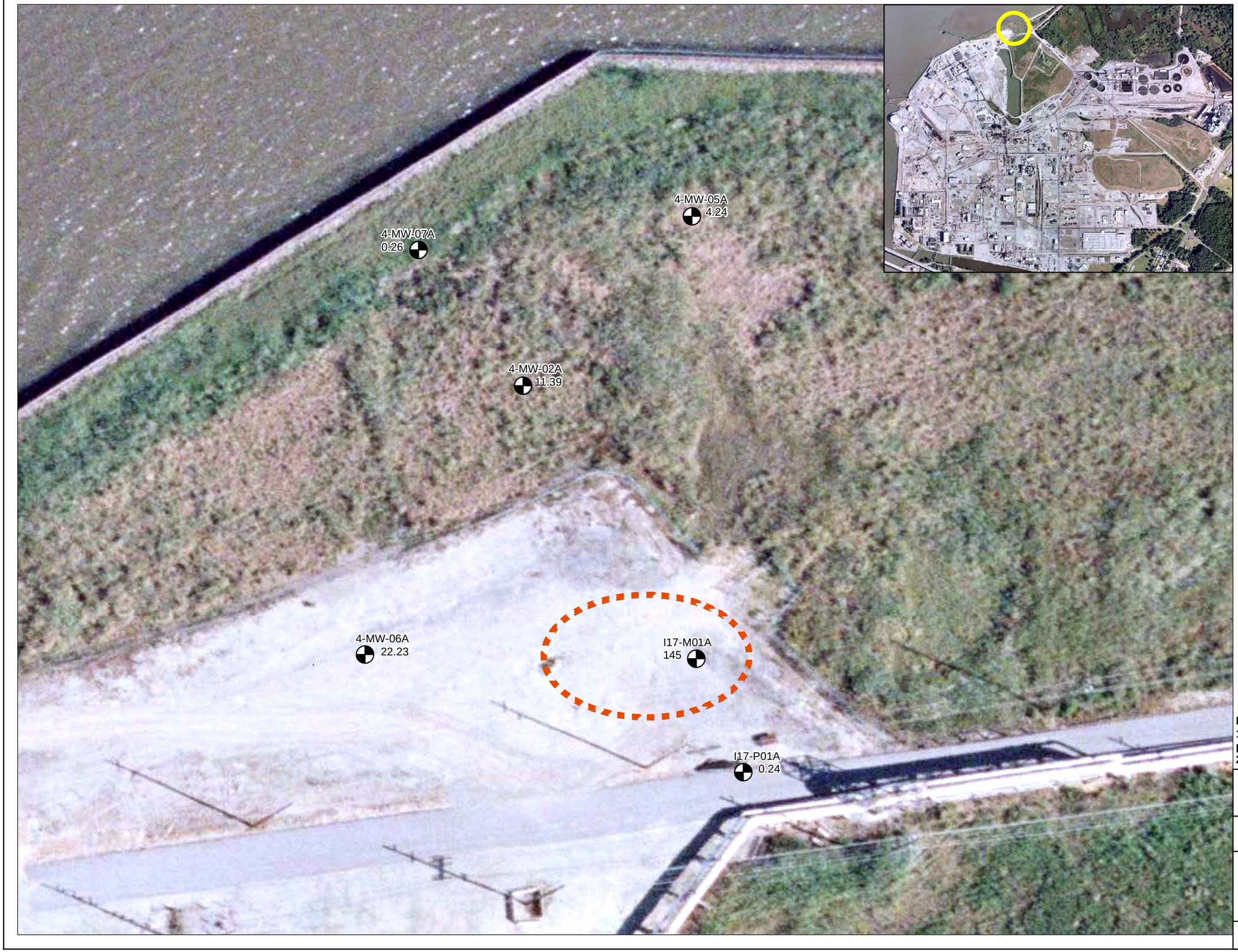
Total Uranium Concentration Trends
AOC 4 - "A" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey



Monitoring Well Location

Total Uranium results that exceeds 30 micrograms per liter (ug/L)

0 20 40 80 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005

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Average Uranium Concentrations in "A" Aquifer - AOC 4

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 21**

FINAL

DO NOT CITE OR QUOTE

N

Monitoring Well Location

0 20 40 80 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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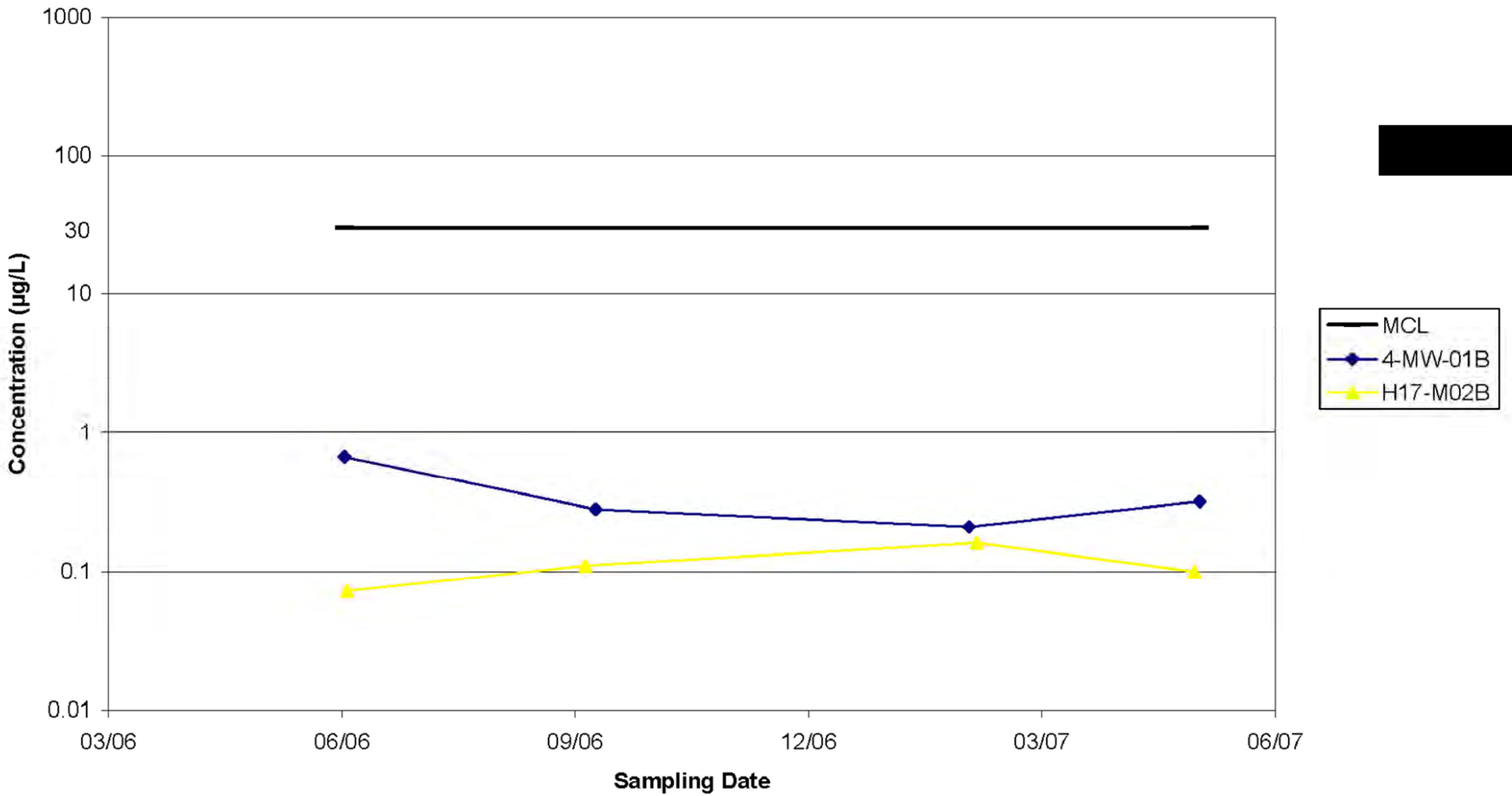
Average Isotopic and Total Uranium for AOC 4 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 6 - 22

Total U Concentrations in Unfiltered Groundwater
Operable Unit 3, Area of Concern 4, Aquifer B
DuPont Chambers Works



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Total Uranium Concentration Trends
AOC 4 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 23

FINAL

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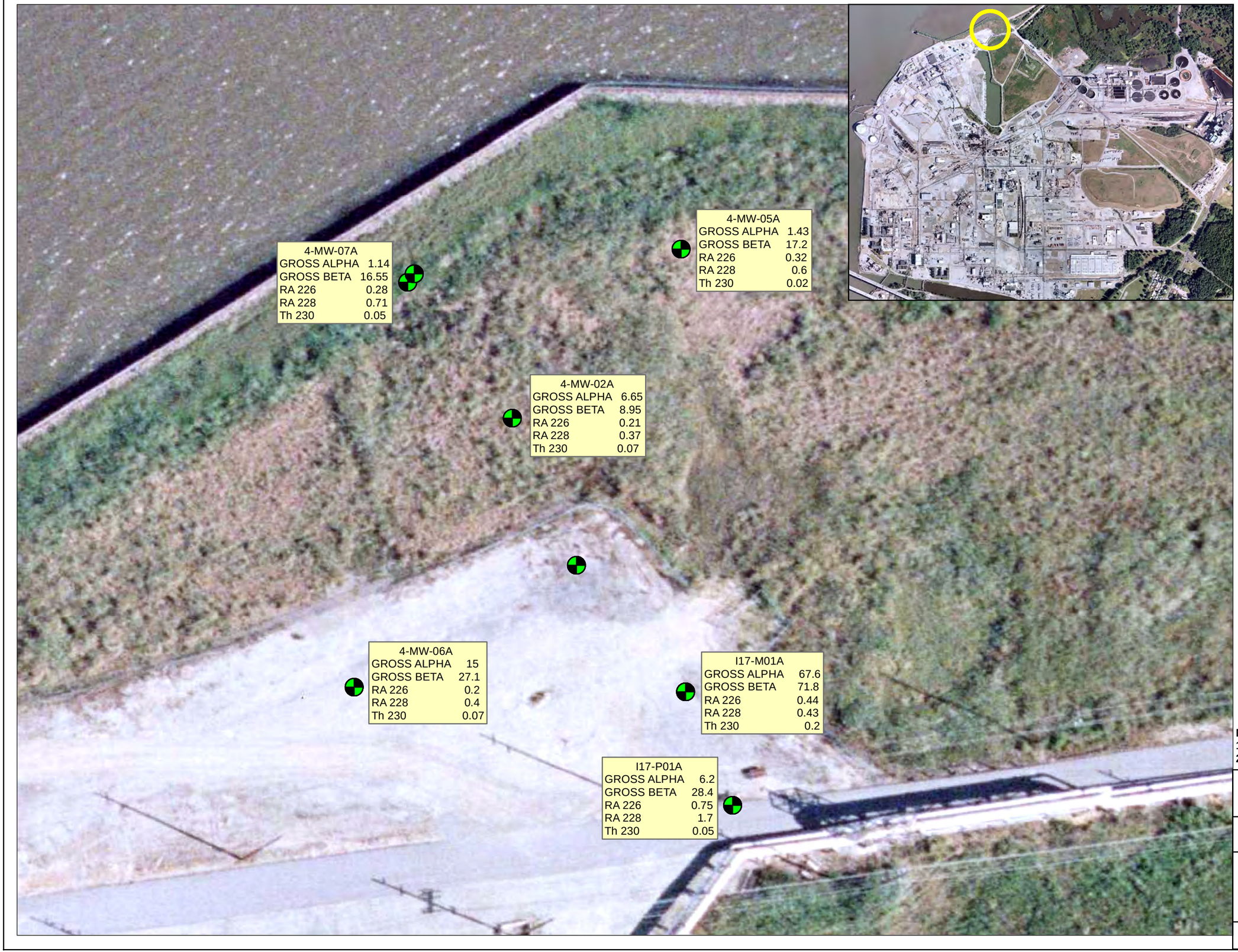

N

Monitoring Well Location

0 20 40 80 Feet

Notes:
1. All results are reported in picoCuries per liter (pCi/L)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis for AOC 4 - "A" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 6 - 24

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4-MW-01B	
GROSS ALPHA	1.2
GROSS BETA	16.3
RA 226	0.23
RA 228	0.87
Th 230	0.02

H17-M02B	
GROSS ALPHA	2.5
GROSS BETA	9.3
RA 226	0.93
RA 228	0.85
Th 230	0.05

Monitoring Well Location

0 20 40 80 Feet

Notes:
1. All results are reported in picoCuries per liter (pCi/L)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis for AOC 4 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 6 - 25

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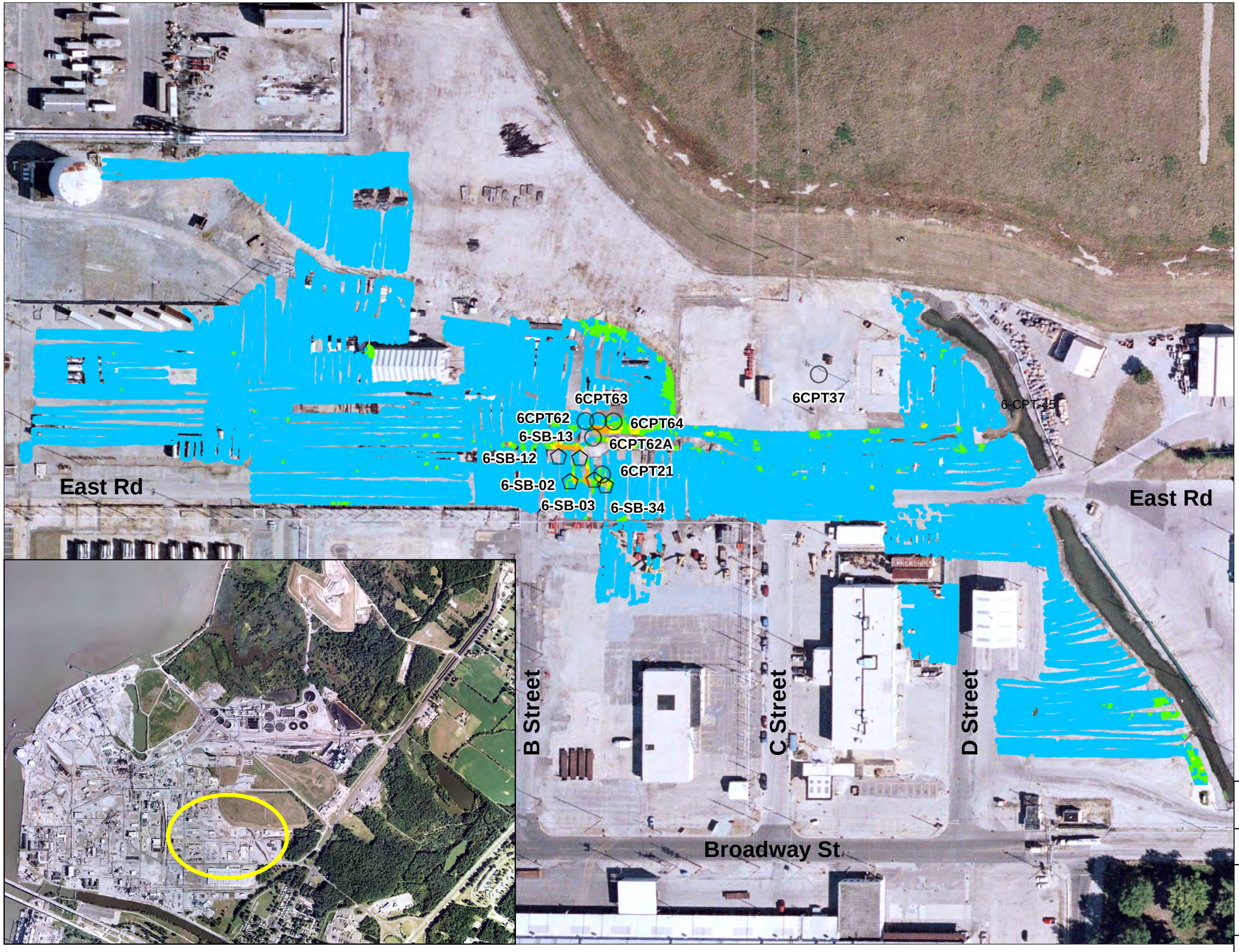

SB Locations

CPT Locations

1 m Contour of Z-Score

- <1
- 1-2
- 2-3
- >3

0 70 140 280 Feet

Note: Aerial Photo taken in September 2005

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AOC 6
Gamma Walkover Survey Results

SITEWIDE REMEDIAL INVESTIGATION
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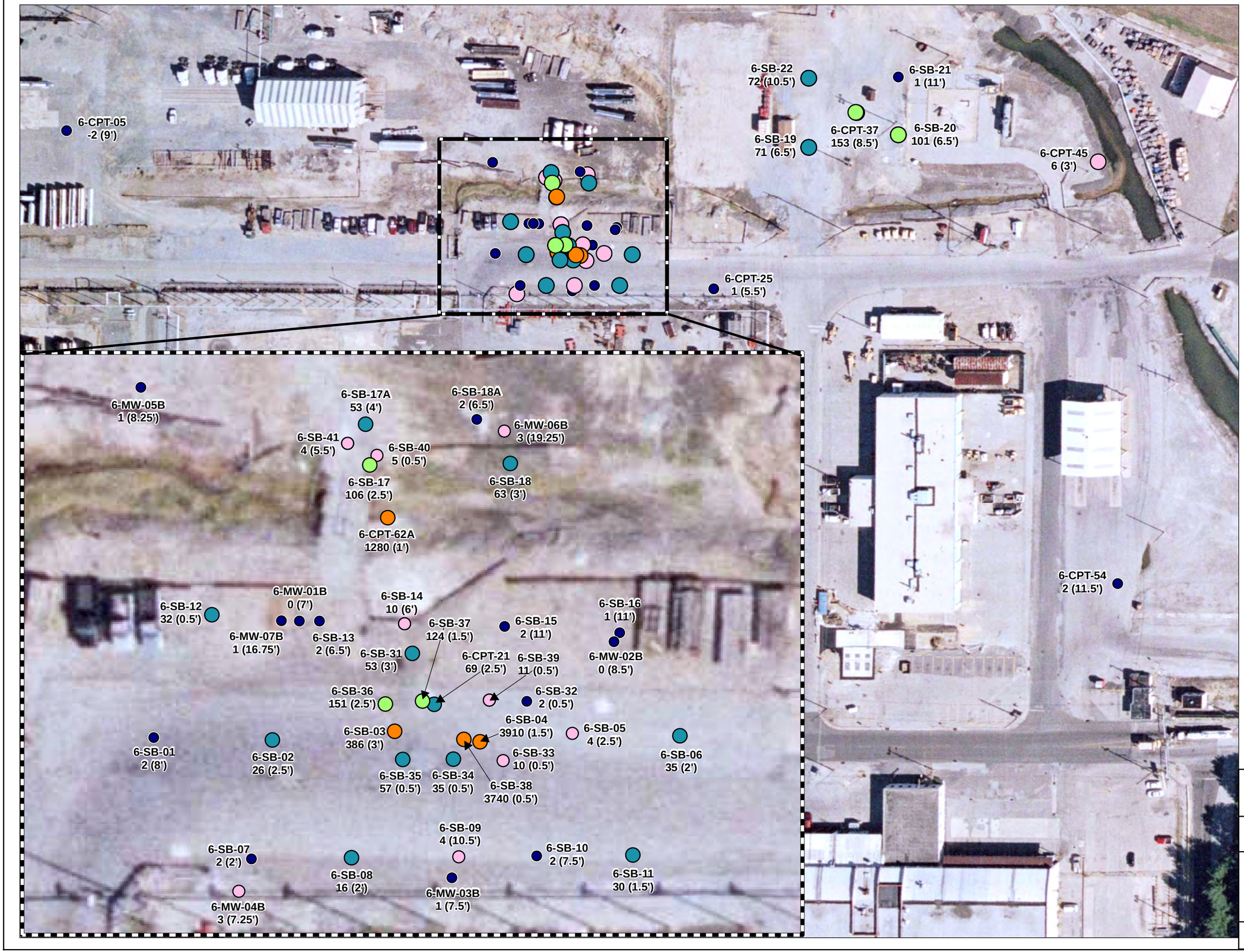
Deepwater, New Jersey

June 2011 | Figure 6 - 26



031003

FINAL

DO NOT CITE OR QUOTE

Total Uranium Concentration in pCi/g and (depth in feet) below ground surface

- > 158
- 76 - 158
- 14 - 75
- 3 - 13
- < 3

6-CPT-37 **Sample Station Location and ID**

0 45 90 180 Feet

Notes:
1.The maximum reported result from either onsite or offsite laboratory analysis is shown at each sample location.
2. Aerial Photo taken in September 2005

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Total Uranium Concentrations in Soil Samples for AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 27**

031003

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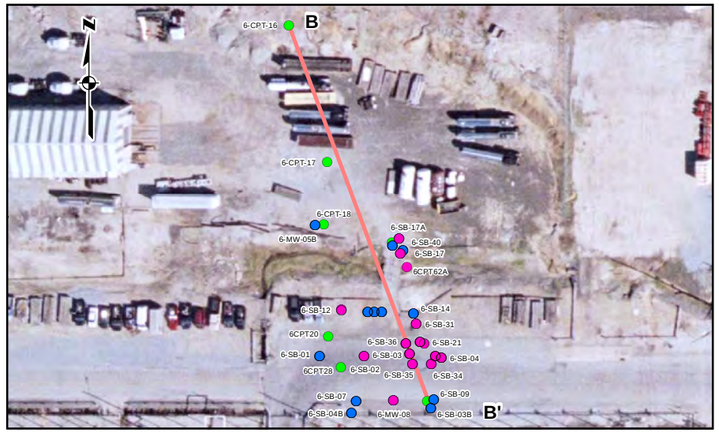

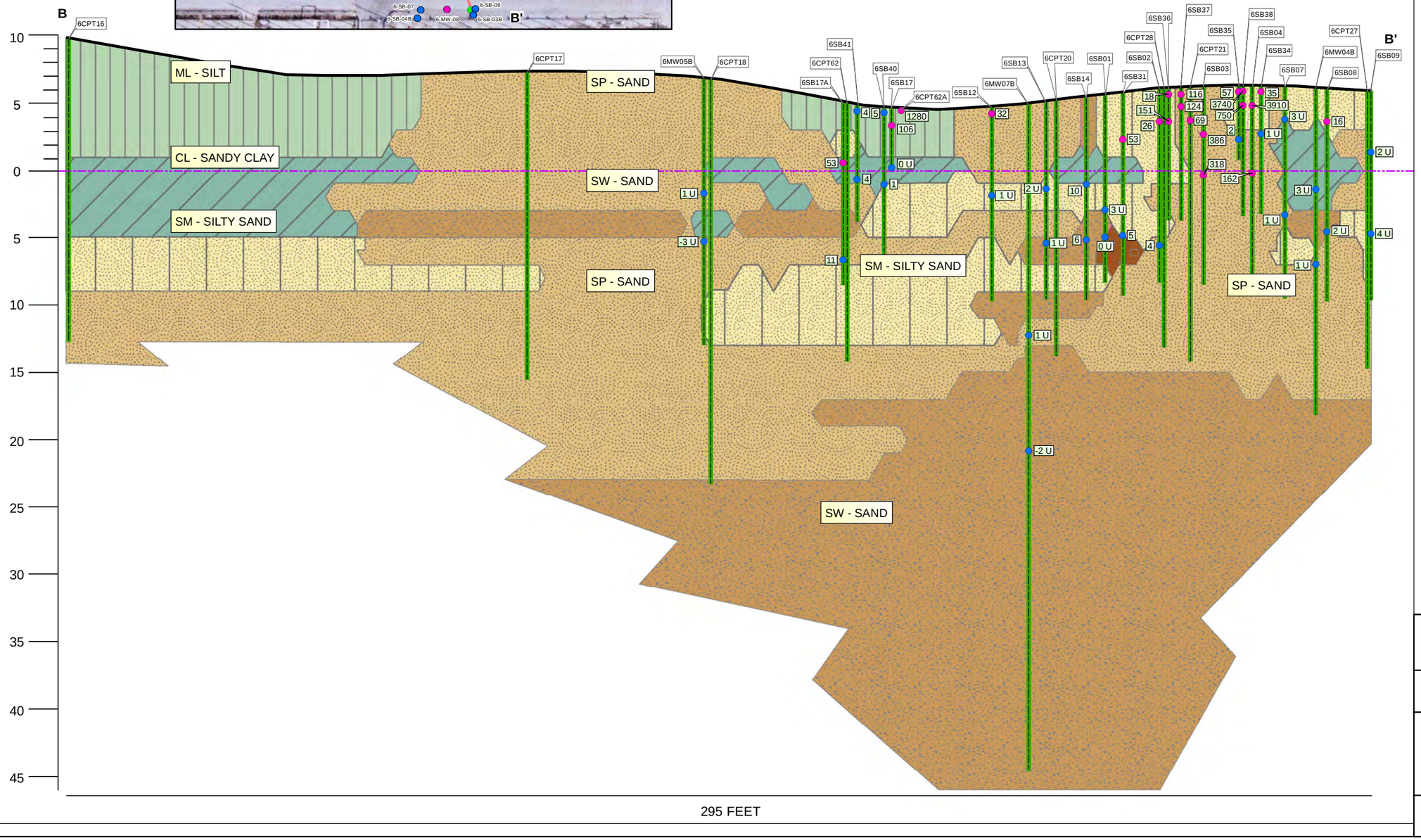

Cross Section (B - B')

Soil Boring

Sample Results

- Uranium Total > 14 pCi/g
- Uranium Total < 14 pCi/g
- 4 Sample Result (pCi/g)
- CPT Location (No Sample)

Soil Classification

- GW - Gravel (Well Graded)
- GP - Gravel (Poorly Graded)
- SW - Sand (Well Graded)
- SP - Sand (Poorly Graded)
- SM - Silty Sand
- SC - Clayey Sand
- ML - Sandy Silt
- CL - Sandy Clay
- MH - Silt
- CH - Clay (High Plasticity)

VERTICAL EXAGGERATION = 3X

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AOC 6 Cross Section (B - B')
Vertical Extent of Uranium Contamination

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 28**

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6-CPT-05
RA 226 0.74

6-SB-22
RA 226 0.86

6-SB-21
RA 226 0.56

6-SB-19
RA 226 0.74

6-CPT-37
RA 226 1.01

6-SB-20
RA 226 1.35

6-CPT-45
RA 226 2.5

6-CPT-25
RA 226 1.59

6-MW-05B
RA 226 1.03
Th 230 0.54

6-SB-17A
RA 226 0.88

6-SB-18A
RA 226 1.13

6-MW-06B
RA 226 1.16
Th 230 0.78

6-SB-41
RA 226 0.82
RA 228 0.75
Th 230 0.54

6-SB-40
RA 226 0.8
RA 228 0.58
Th 230 0.67

6-SB-18
RA 226 1.58

6-SB-17
RA 226 0.99

6-CPT-62A
RA 226 1.7

6-MW-07B
RA 226 0.73
Th 230 0.27

6-SB-13
RA 226 1.28

6-SB-14
RA 226 1.03

6-SB-12
RA 226 1.37

6-SB-15
RA 226 0.71

6-SB-16
RA 226 1.47

6-MW-01B
RA 226 0.89

6-SB-31
RA 226 0.94

6-SB-37
RA 226 0.88
RA 228 0.71
Th 230 0.49

6-SB-39
RA 226 0.74
RA 228 0.69
Th 230 0.48

6-MW-02B
RA 226 0.87

6-CPT-21
RA 226 0.85

6-SB-32
RA 226 0.9
RA 228 0.73
Th 230 0.54

6-SB-36
RA 226 0.64
RA 228 0.75
Th 230 0.51

6-SB-01
RA 226 1.46

6-SB-02
RA 226 1.01

6-SB-03
RA 226 0.81

6-SB-04
RA 226 14.3

6-SB-05
RA 226 1.03

6-SB-06
RA 226 0.97

6-SB-35
RA 226 1.33
RA 228 0.62
Th 230 1.17

6-SB-34
RA 226 0.78
RA 228 0.8
Th 230 0.51

6-SB-38
RA 226 9.8
RA 228 0.33
Th 230 69

6-SB-33
RA 226 0.93
RA 228 1.04
Th 230 0.75

6-CPT-54
RA 226 1.48

6-SB-07
RA 226 0.95

6-MW-04B
RA 226 1.58
Th 230 1.04

6-SB-08
RA 226 1.16

6-SB-09
RA 226 1.99

6-MW-03B
RA 226 1.62

6-SB-10
RA 226 1.46

6-SB-11
RA 226 1.46

Sample Station Location

0 45 90 180 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis in Soils for AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 29

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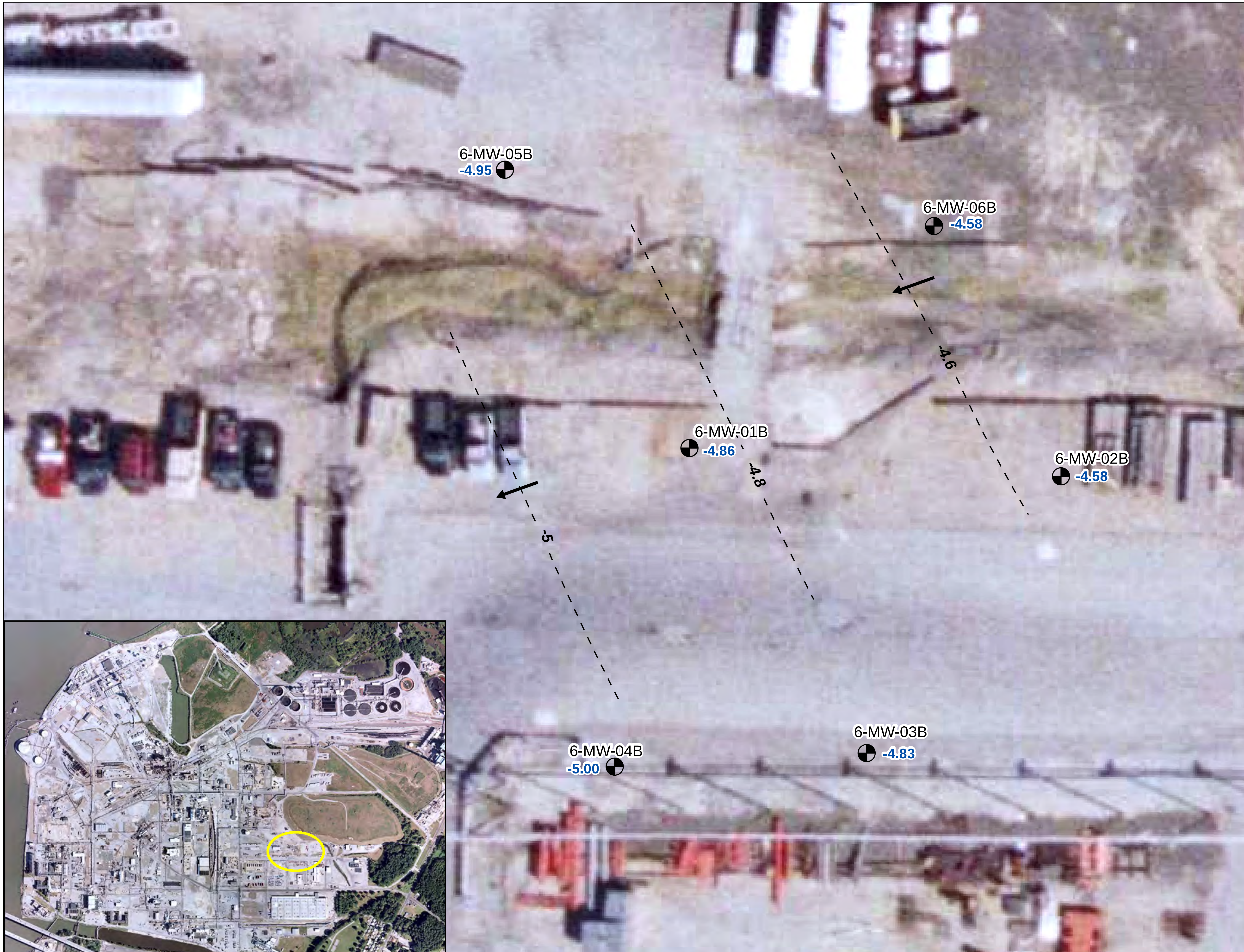

N

Aquifer "B" Well

-4.83 Groundwater Elevation Ft NAVD 88

-5 Groundwater Elevation Contour
Contour Interval 0.2 Foot

(Arrow indicates Groundwater Flow Direction)

0 12.5 25 50 Feet

Note: Aerial Photo taken in September 2005

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Groundwater Elevation "B" Aquifer AOC 6 - Quarter 5 (Sept 2006)

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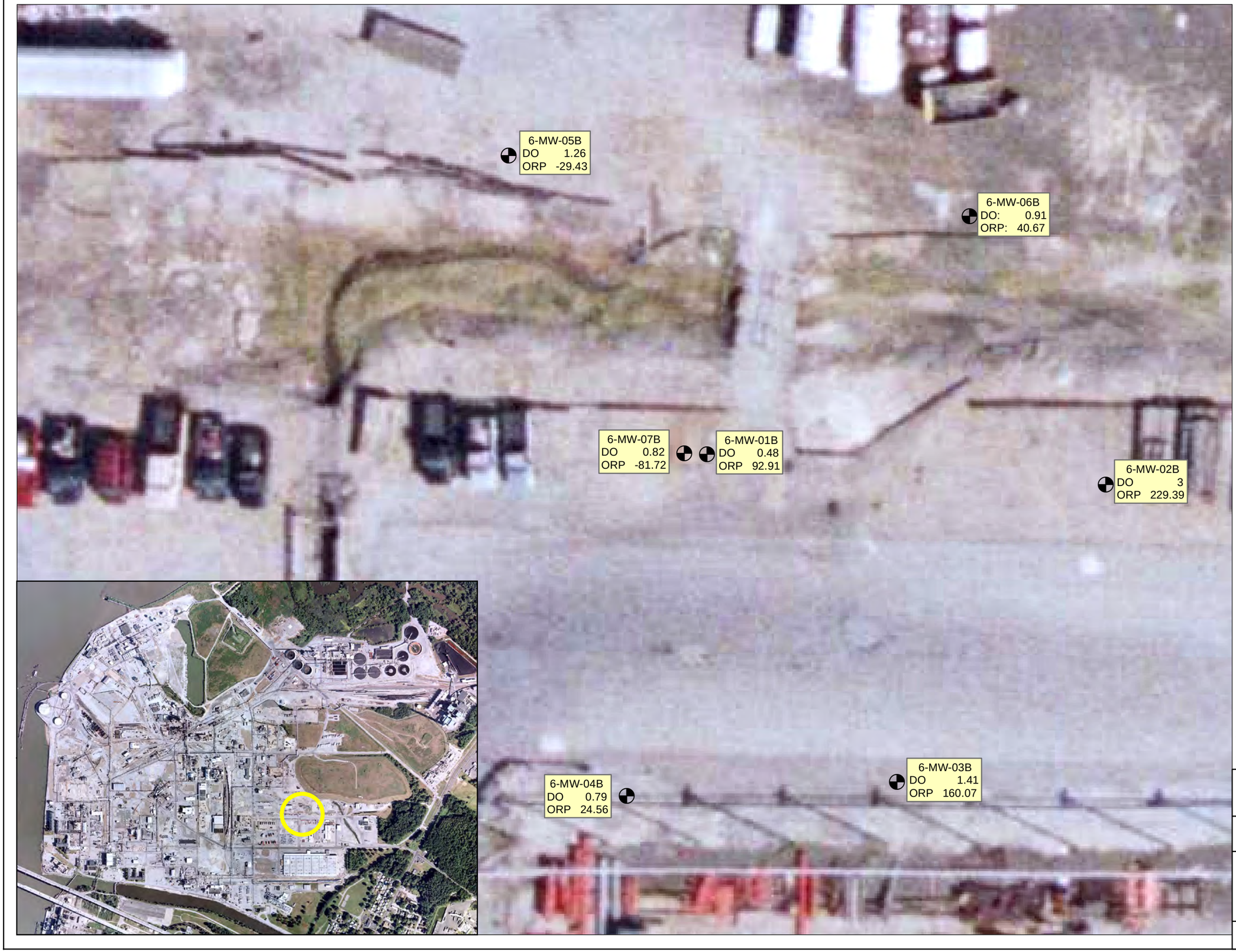
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

	June 2011	Figure 6 - 30



N

Sample Station Location

0 10 20 40 Feet

Notes:
1. Dissolved Oxygen (DO) is reported in ug/L
2. Oxygen Reduction Potential (ORP) is reported in millivolts
3. Aerial Photo taken in September 2005

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Average DO and ORP Values in Groundwater for AOC 6

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 31

Monitoring Well Location with Uranium results above 30 microgram per liter (ug/L)

Monitoring Well Location

0 10 20 40 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. U234, U235 and U238 results are reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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Average Isotopic and Total Uranium for AOC 6 - "B" Aquifer

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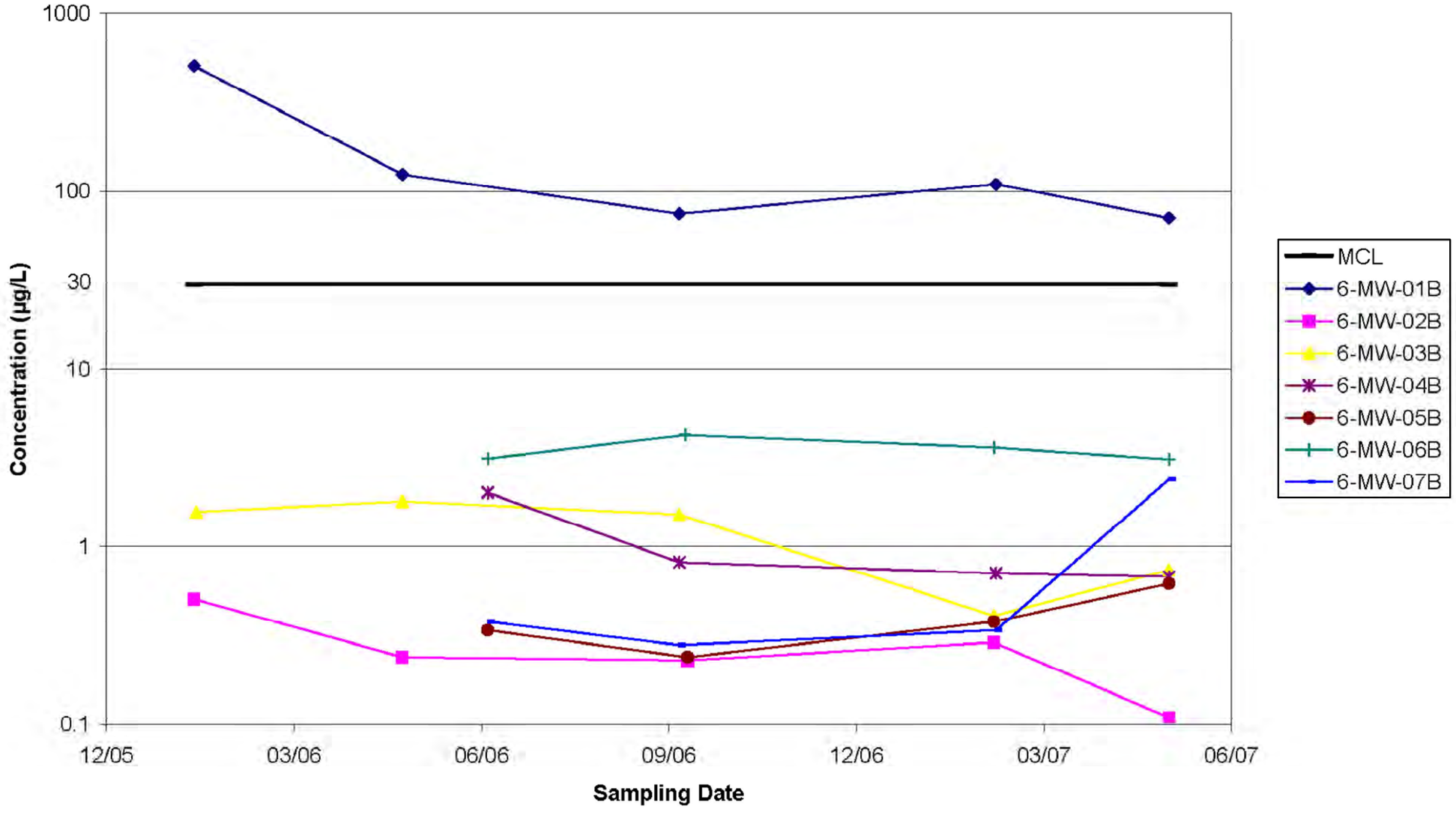
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 32**

Total Uranium Concentrations In Unfiltered Groundwater
Operable Unit 3, Area of Concern 6, Aquifer B
DuPont Chambers Works



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Total Uranium Concentration Trends
AOC 6 - "B" Aquifer

SITEWIDE REMEDIAL INVESTIGATION
USACE-FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | **Figure 6 - 33**

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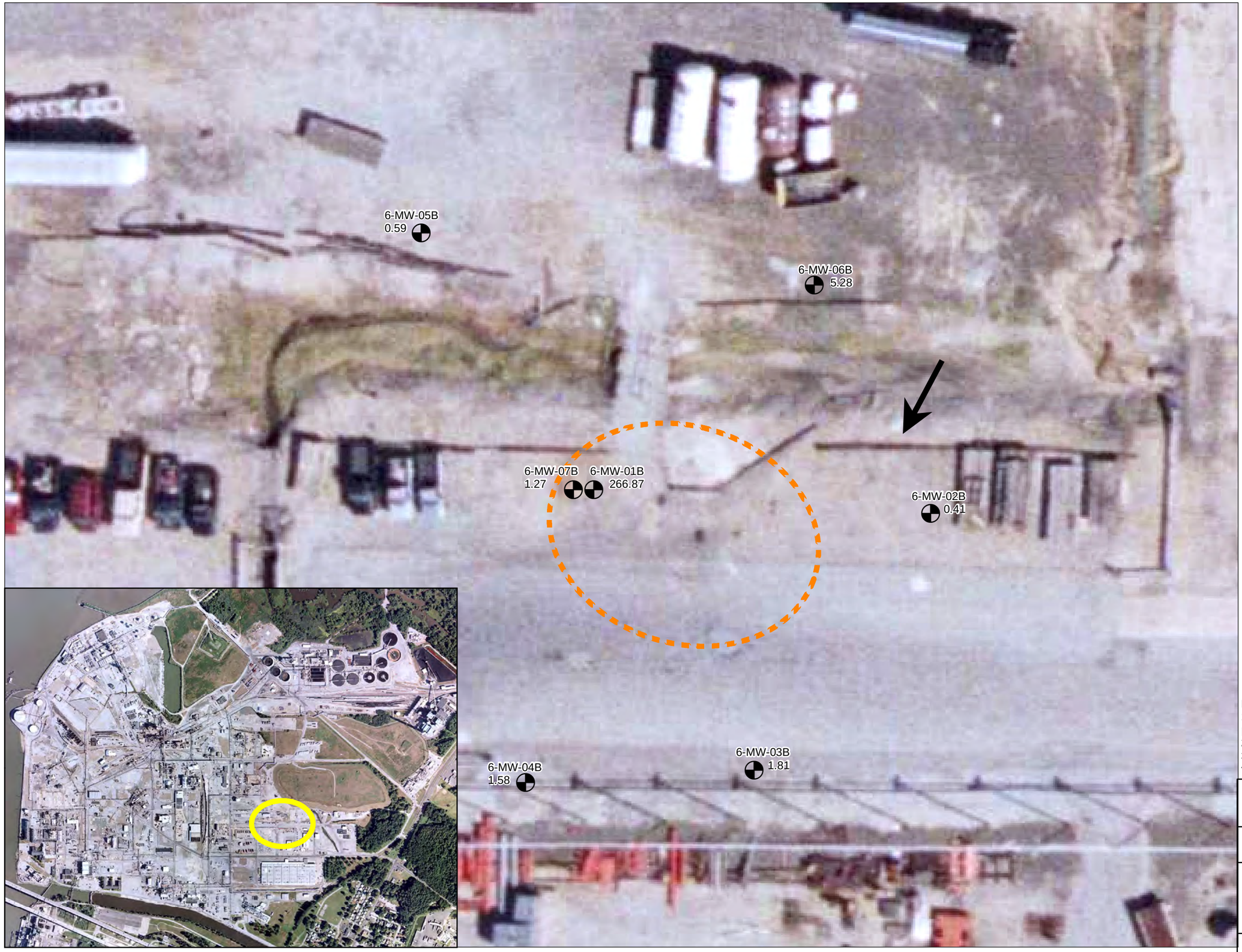

Monitoring Well Location

Total Uranium results that exceeds 30 micrograms per liter (ug/L)

Average Groundwater Flow Direction

0 10 20 40 Feet

Notes:
1. Total Uranium results are reported in micrograms per liter (ug/L)
2. Aerial Photo taken in September 2005
3. 6MW07B is completed at the base of the B Aquifer for vertical delineation

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Average Uranium Concentrations in "B" Aquifer, AOC 6

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 34

N

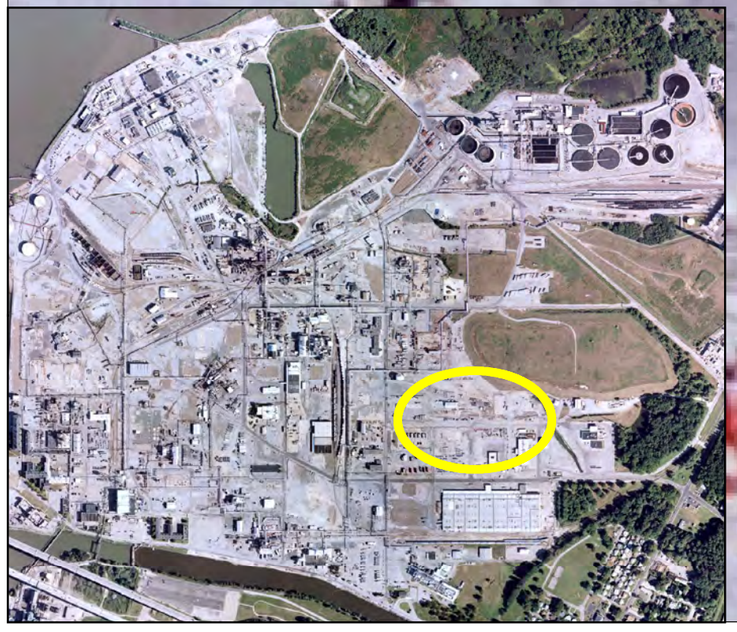
6-MW-05B	
GROSS ALPHA	1.4
GROSS BETA	5.3
RA 226	0.06
RA 228	0.4
Th 230	0.07

6-MW-06B	
GROSS ALPHA	3.2
GROSS BETA	5.7
RA 226	0.12
RA 228	0.5
Th 230	0.02

6-MW-07B	
GROSS ALPHA	2.1
GROSS BETA	14.3
RA 226	0.15
RA 228	0.58
Th 230	-0.01

6-MW-01B	
GROSS ALPHA	119
GROSS BETA	58.5
RA 226	0.37
RA 228	1.03
Th 230	0.39

6-MW-02B	
GROSS ALPHA	1.64
GROSS BETA	5.06
RA 226	0.43
RA 228	0.94
Th 230	0



6-MW-04B	
GROSS ALPHA	2.4
GROSS BETA	8.1
RA 226	0.43
RA 228	0.91
Th 230	0.01

6-MW-03B	
GROSS ALPHA	3.2
GROSS BETA	7.8
RA 226	0.54
RA 228	1.22
Th 230	-0.01

Monitoring Well Location

0 10 20 40 Feet

Notes:
1. All results are reported in picoCuries per liter (pCi/L)
2. Aerial Photo taken in September 2005

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Radiochemical Analysis for AOC 6 - "B" Aquifer

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

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N

6-SW-01	
Uranium Total	0.37
GROSS ALPHA	0.66
GROSS BETA	6.8
RA 226	0.082
RA 228	0.21
Th 230	-0.043

6-SW-04	
Uranium Total	0.4
GROSS ALPHA	2.6
GROSS BETA	7.7
RA 226	0.08
RA 228	0.59
Th 230	0.013

6-SW-05	
Uranium Total	0.3
GROSS ALPHA	1.4
GROSS BETA	4.9
RA 226	0.12
RA 228	-0.2
Th 230	0.003

6-SW-06	
Uranium Total	0.36
GROSS ALPHA	1.9
GROSS BETA	7.2
RA 226	0.15
RA 228	-0.03
Th 230	0.007

6-SW-07	
Uranium Total	1.14
GROSS ALPHA	1.78
GROSS BETA	6.2
RA 226	0.12
RA 228	0.45
Th 230	-0.007

6-SW-08	
Uranium Total	1.92
GROSS ALPHA	3.8
GROSS BETA	10.3
RA 226	0.049
RA 228	0.25
Th 230	0.004

6-SW-02	
Uranium Total	265
GROSS ALPHA	89
GROSS BETA	83
RA 226	0.17
RA 228	0.64
Th 230	0.002

6-SW-09	
Uranium Total	3.03
GROSS ALPHA	5.2
GROSS BETA	9.2
RA 226	0.17
RA 228	0.37
Th 230	-0.029

6-SW-10	
Uranium Total	1.75
GROSS ALPHA	4.3
GROSS BETA	7.9
RA 226	0.13
RA 228	0.19
Th 230	-0.019

6-SW-11	
Uranium Total	1.35
GROSS ALPHA	4.8
GROSS BETA	7
RA 226	0.026
RA 228	0.14
Th 230	0.058

6-SW-12	
Uranium Total	1.18
GROSS ALPHA	3.3
GROSS BETA	5.4
RA 226	0.09
RA 228	0.12
Th 230	0.065

6-SW-13	
Uranium Total	1.32
GROSS ALPHA	2.5
GROSS BETA	5.2
RA 226	0.054
RA 228	0.19
Th 230	0

Surface Water Sample Location with total uranium results above 30 micrograms per liter (ug/L)

Surface Water Sample Location

0 10 20 40 Feet

Notes:

1. Total uranium results reported in micrograms per liter (ug/L)
2. All other results are reported in picoCuries per liter (pCi/L)
3. Aerial Photo taken in September 2005

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Total Uranium and Radiochemical Analysis in Surface Water for AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 36

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N

6-SD-01	
Uranium Total	0
RA 226	0.16
Th 230	0.274

6-SD-04	
Uranium Total	0.47
RA 226	0.12
RA 228	0.28
Th 230	0.208

6-SD-05	
Uranium Total	0.31
RA 226	0.24
RA 228	0.2
Th 230	0.255

6-SD-06	
Uranium Total	0.67
RA 226	0.22
RA 228	0.52
Th 230	0.32

6-SD-07	
Uranium Total	1.03
RA 226	0.45
RA 228	0.53
Th 230	0.268

6-SD-08	
Uranium Total	1.65
RA 226	0.3
RA 228	0.36
Th 230	0.232

6-SD-02	
Uranium Total	13
RA 226	0.62
Th 230	0.268

6-SD-09	
Uranium Total	0.81
RA 226	0.27
RA 228	0.22
Th 230	0.177

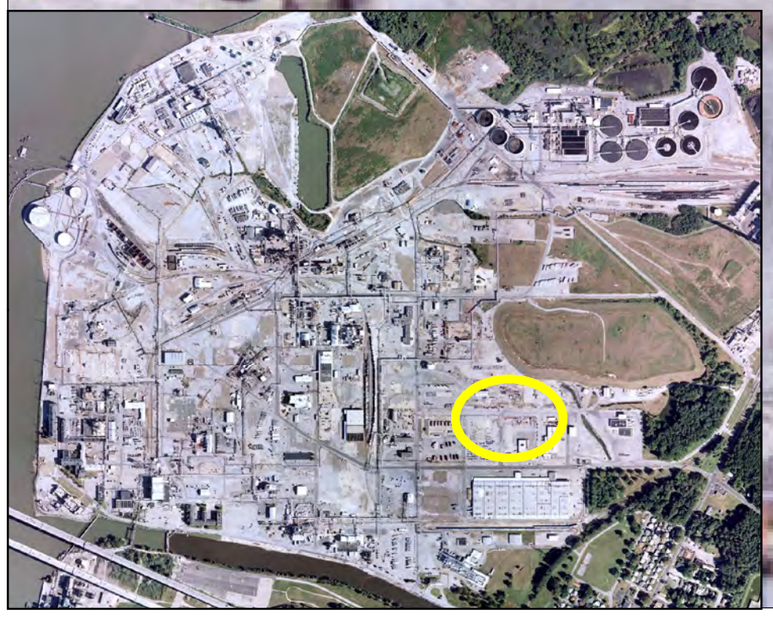
6-SD-10	
Uranium Total	2.94
RA 226	0.3
RA 228	0.28
Th 230	0.289

6-SD-11	
Uranium Total	18.4
RA 226	1.6
RA 228	0.89
Th 230	1.04

6-SD-12	
Uranium Total	3.97
RA 226	0.33
RA 228	0.46
Th 230	0.43

6-SD-13	
Uranium Total	0.7
RA 226	0.35
RA 228	0.41
Th 230	0.5

6-SD-03	
Uranium Total	0.3
RA 226	0.25
Th 230	0.315



Sediment
Sample Location

0 12.5 25 50 Feet

Notes:
1. All results are reported in picoCuries per gram (pCi/g)
2. Aerial Photo taken in September 2005

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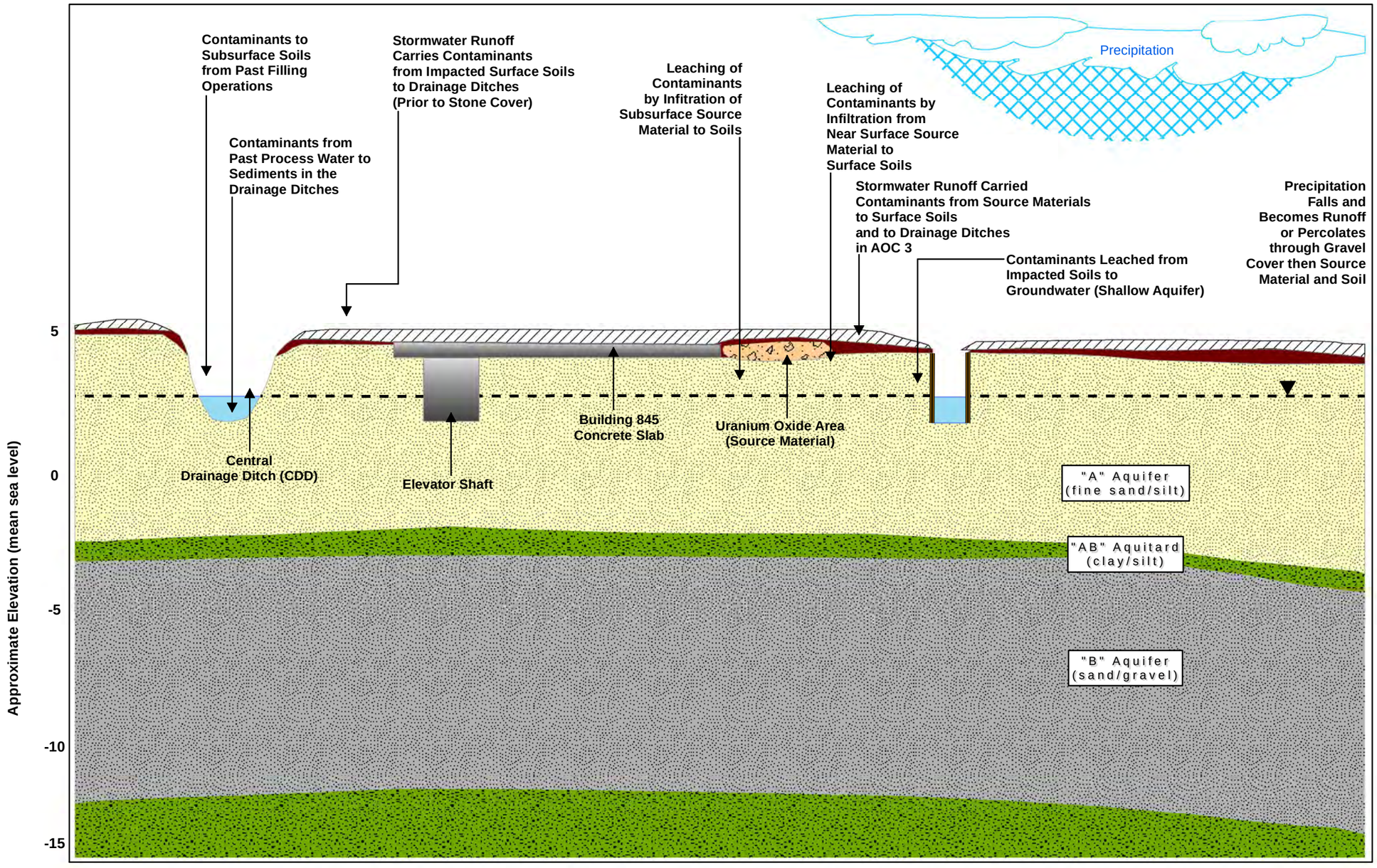
Total Uranium and Radiochemical Analysis in Sediment Samples for AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 6 - 37



"A" Aquifer (fine sand/silt)
"AB" Aquitard (clay/silt)
"B" Aquifer (fine sand/silt)
Concrete Slab
Source Material
Stone Cover
Surface Soils
Surface Water
Wooden Trough
Water Table

Note: Not drawn to scale

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Potential Routes of Migration in AOC 1

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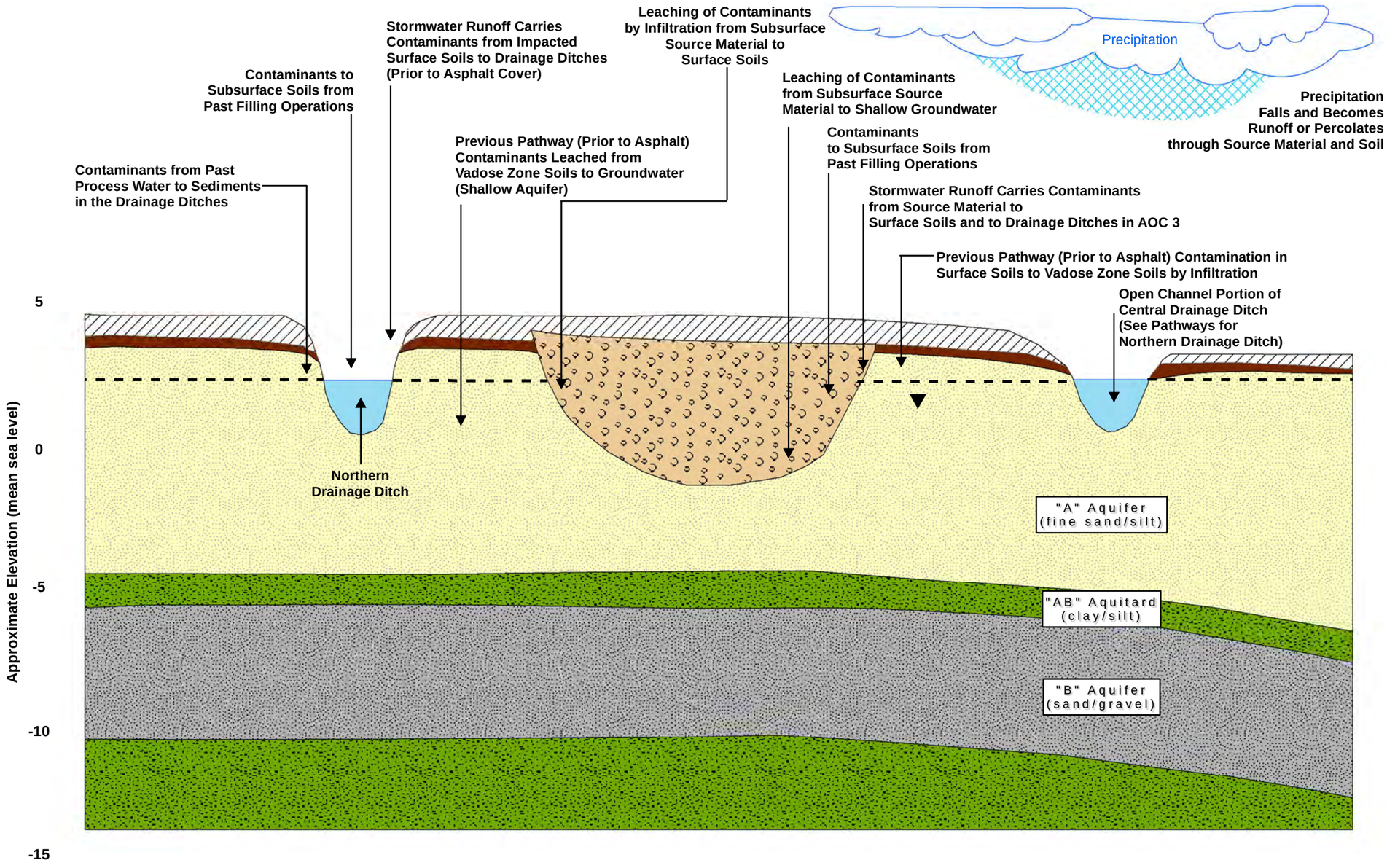
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 7 - 1



Note: Not drawn to scale

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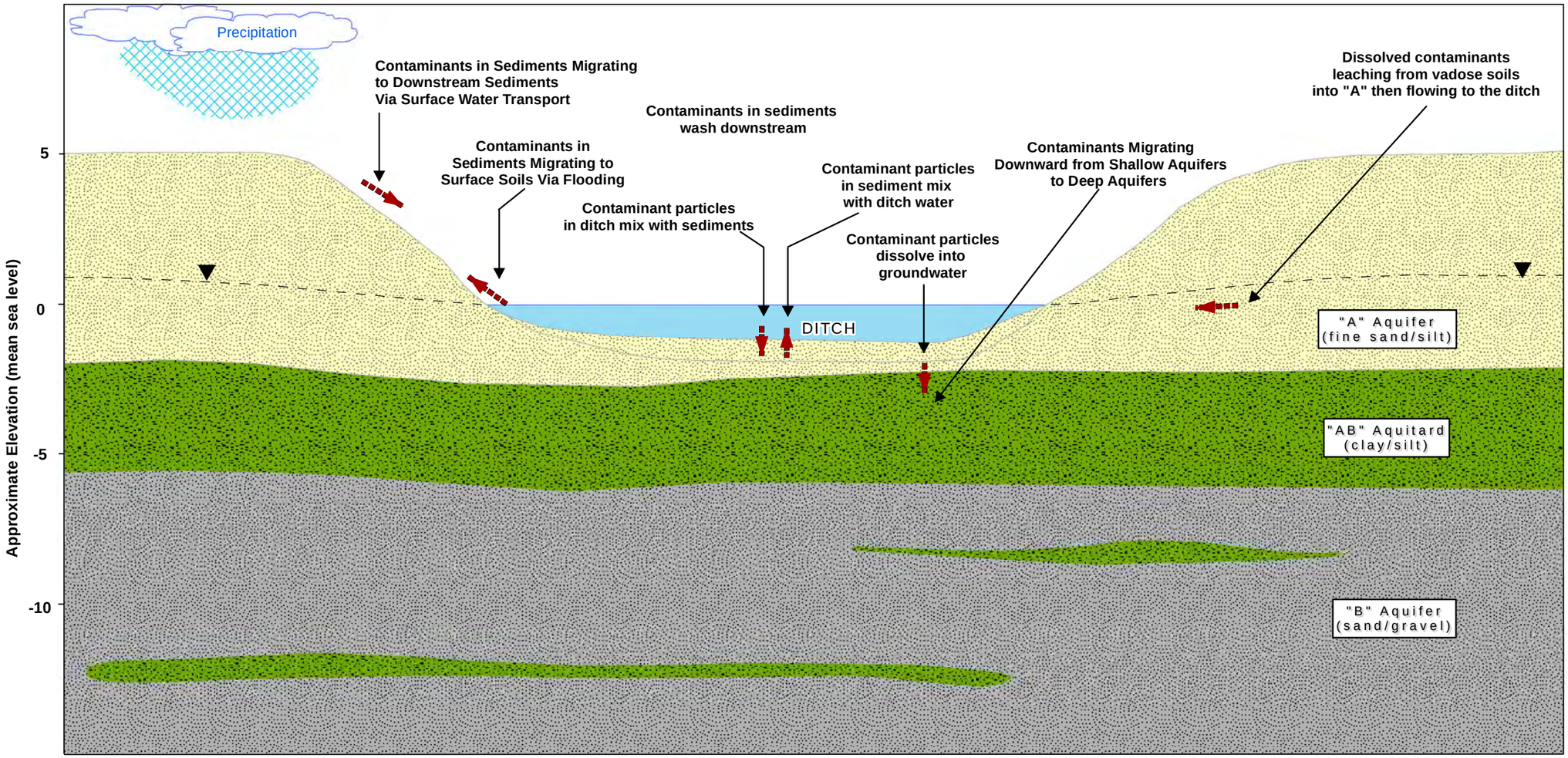
Potential Routes of Migration in AOC 2

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 7 - 2



"A" Aquifer (fine sand /silt)

"AB" Aquitard (clay/silt)

"B" Aquifer (fine sand /silt)

Surface Water

Water Table

Note: Not drawn to scale

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Potential Routes of Migration in AOC 3

SITWIDE REMEDIAL INVESTIGATION
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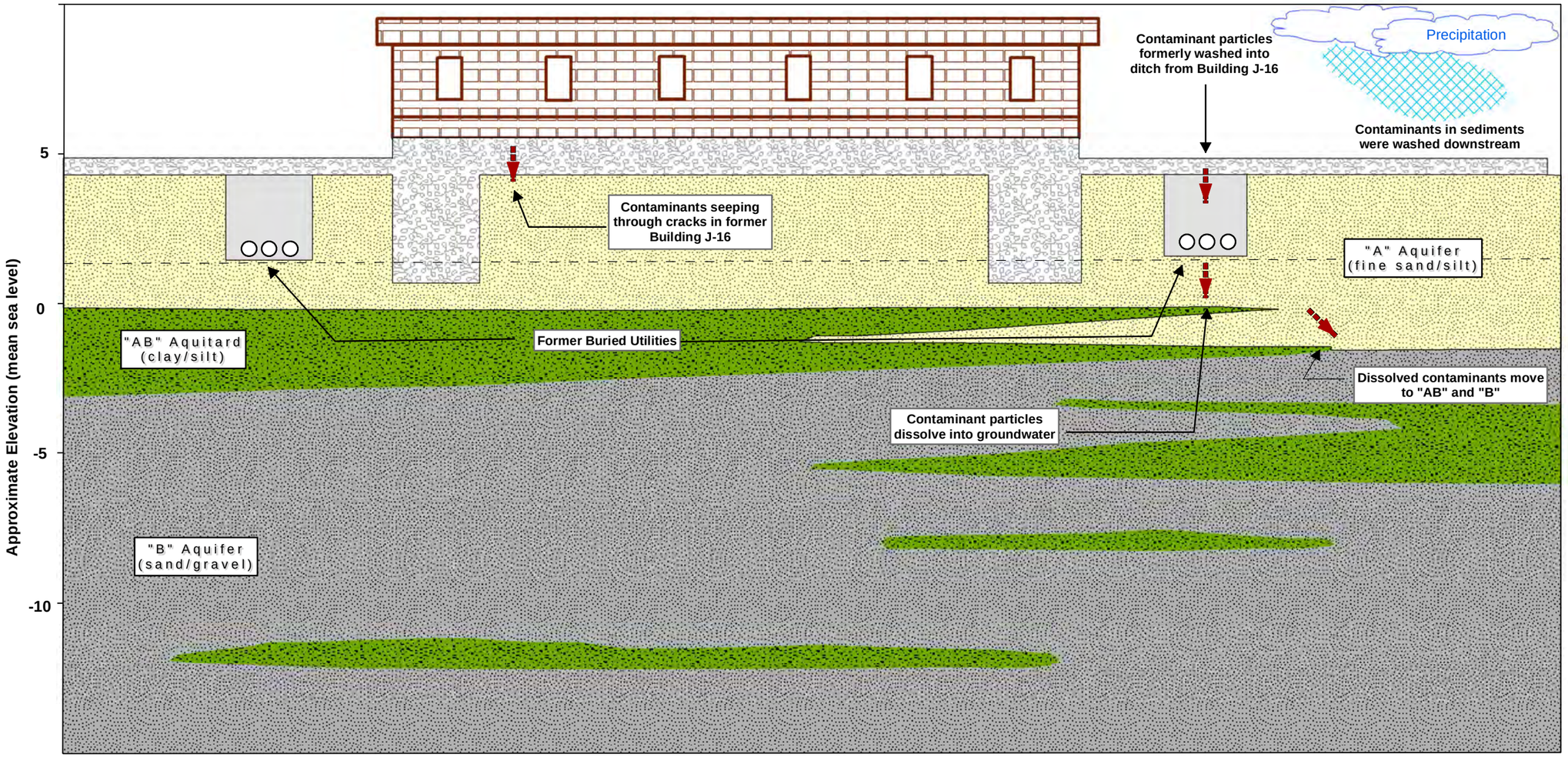
June 2011 | **Figure 7 - 3**



Building J-26

Former Building J-16

Former Buried Utilities

"A" Aquifer (fine sand/silt)

"AB" Aquitard (clay/silt)

"B" Aquifer (sand/gravel)

Note: Not drawn to scale

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Potential Routes of Migration in AOC 5

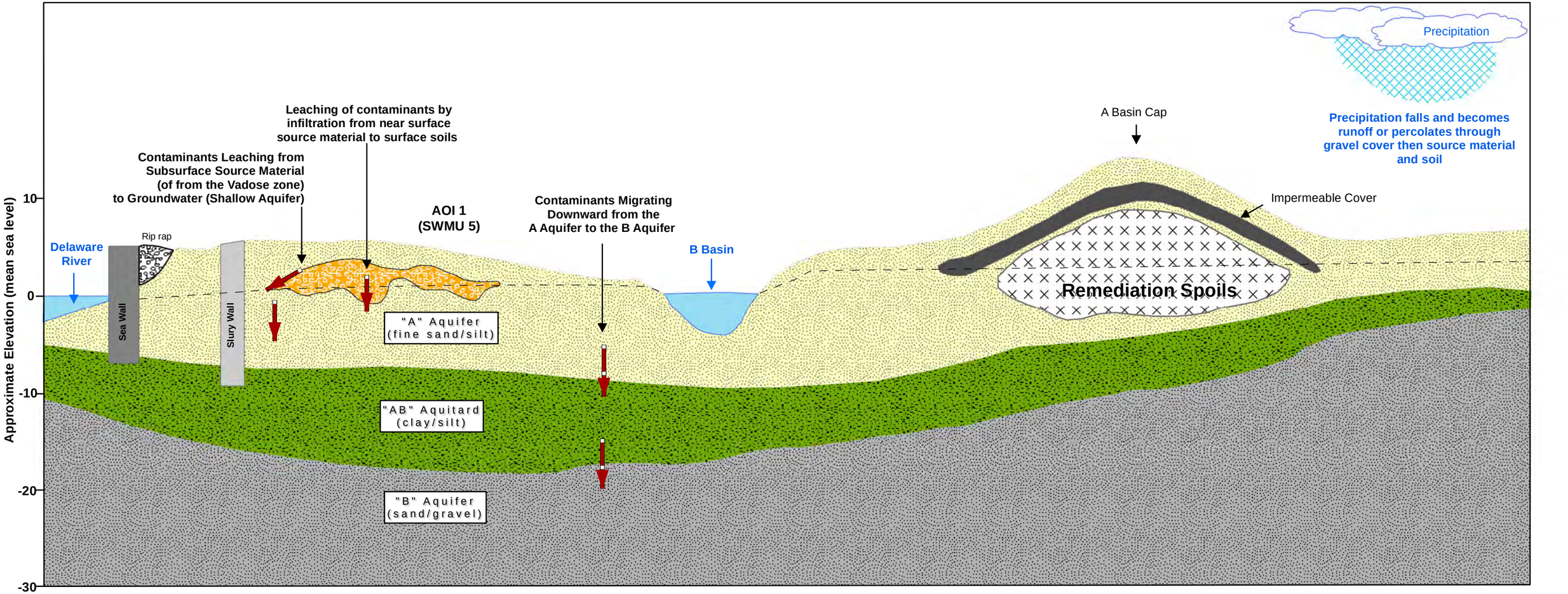
SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 7 - 4

NORTHWEST

SOUTHEAST



- Rip rap
- Debris
- Remediation Spoils from CDD
- Surface Water
- Slury Wall
- Sea Wall
- Impermeable Cover
- "A" Aquifer (fine sand /silt)
- "AB" Aquitard (clay/silt)
- "B" Aquifer (sand/gravel)

Note: Not drawn to scale

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Potential Routes of Migration in AOC 4

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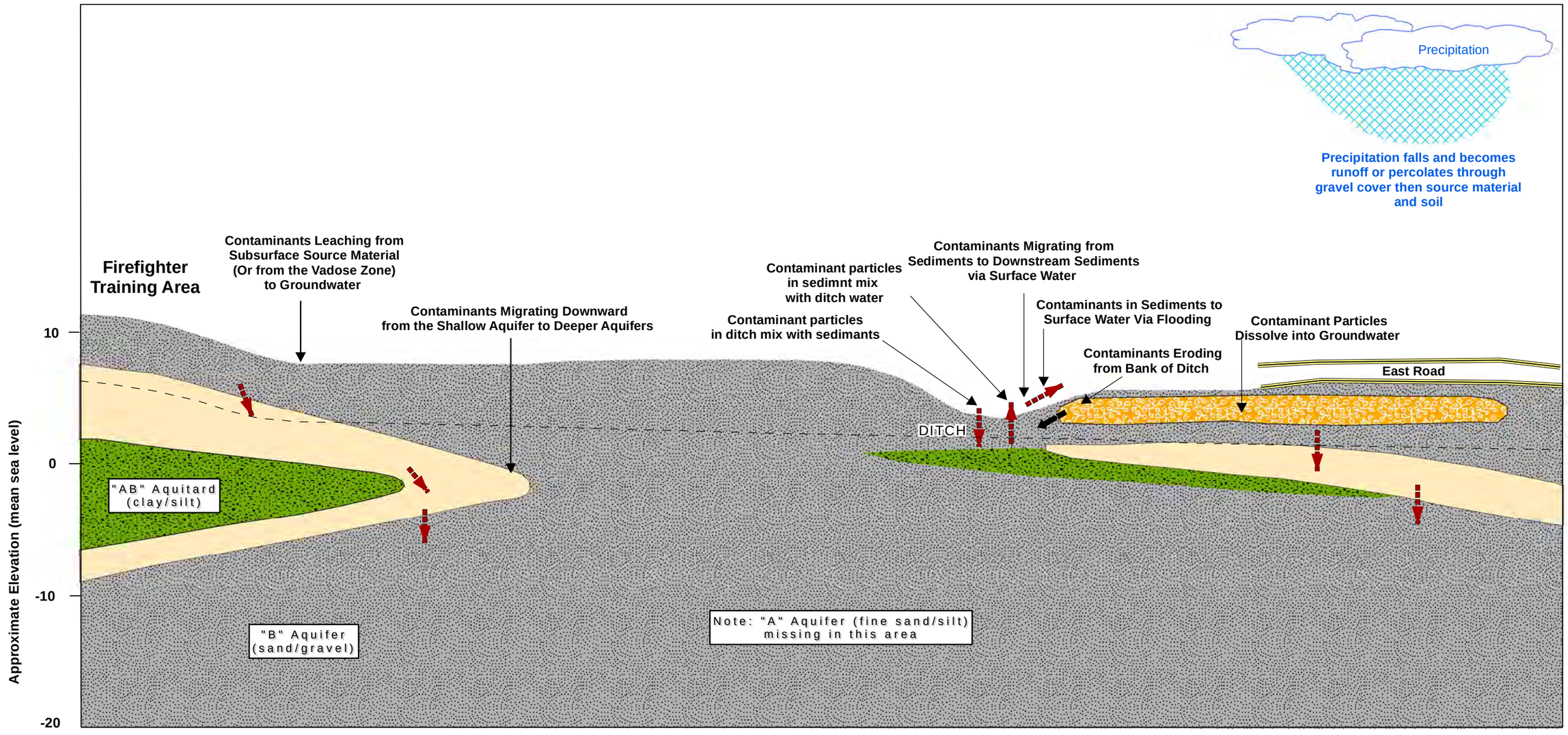
June 2011 | Figure 7 - 5

NORTH

SOUTH



Note: Not drawn to scale

Waste and Debris

"AB" Aquitard (clay/silt)

ML (Well-graded silts)

"B" Aquifer (fine sand /silt)

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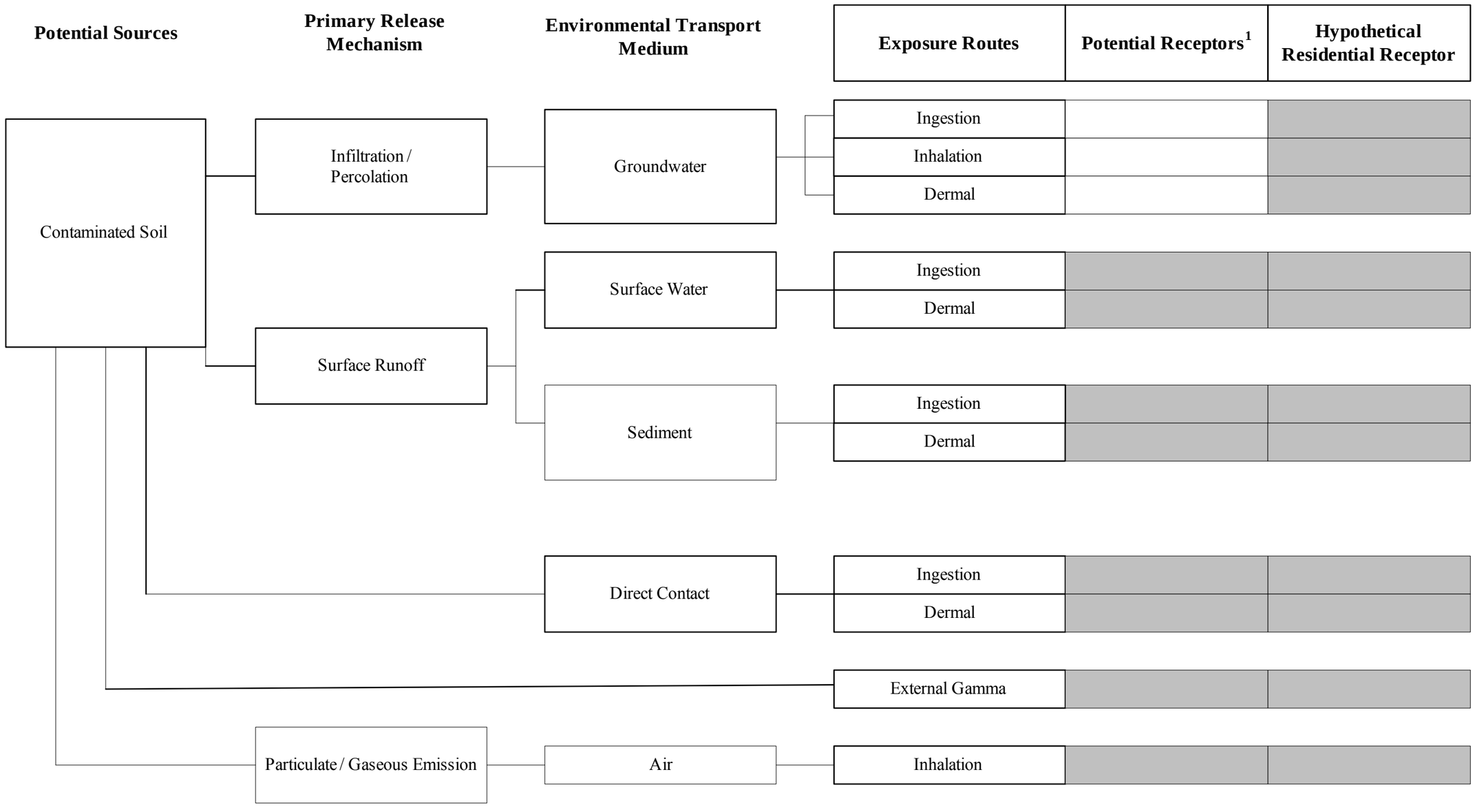
Potential Routes of Migration in AOC 6

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011

Figure 7 - 6



Complete Exposure Pathway

Incomplete Exposure Pathway

[1] Potential receptors include industrial , construction, utility and maintenance workers

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General Conceptual Site Model for Human Health Risk Assessment

SITEWIDE REMEDIAL INVESTIGATION
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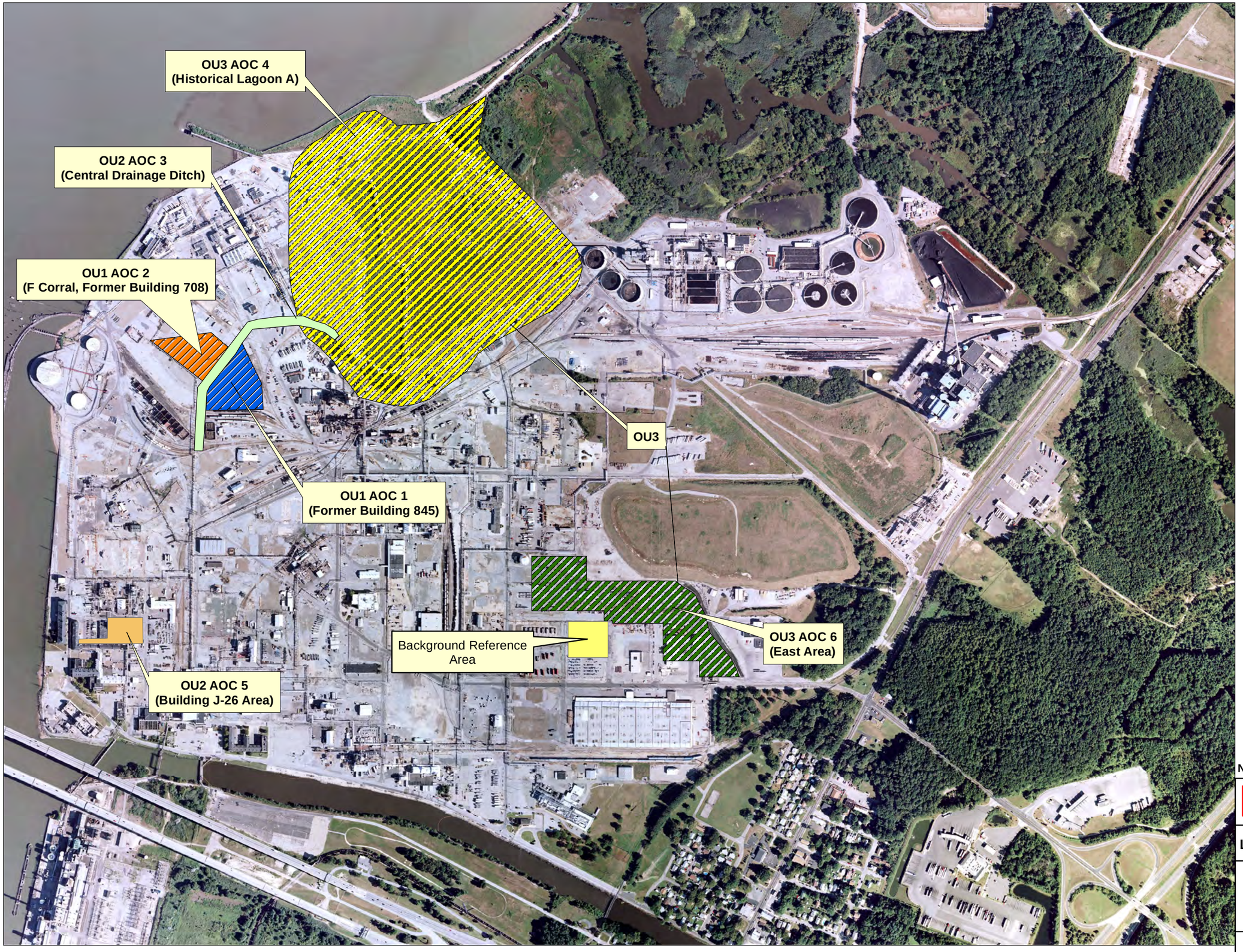
Deepwater, New Jersey

June 2011 | Figure 7 - 7



031003

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OU1

- AOC 1
- AOC 2

OU2

- AOC 3
- AOC 5

OU3

- AOC 4
- AOC 6
- Background Reference Area

0 380 760 1,520 Feet

Note: Aerial Photo taken in September 2005

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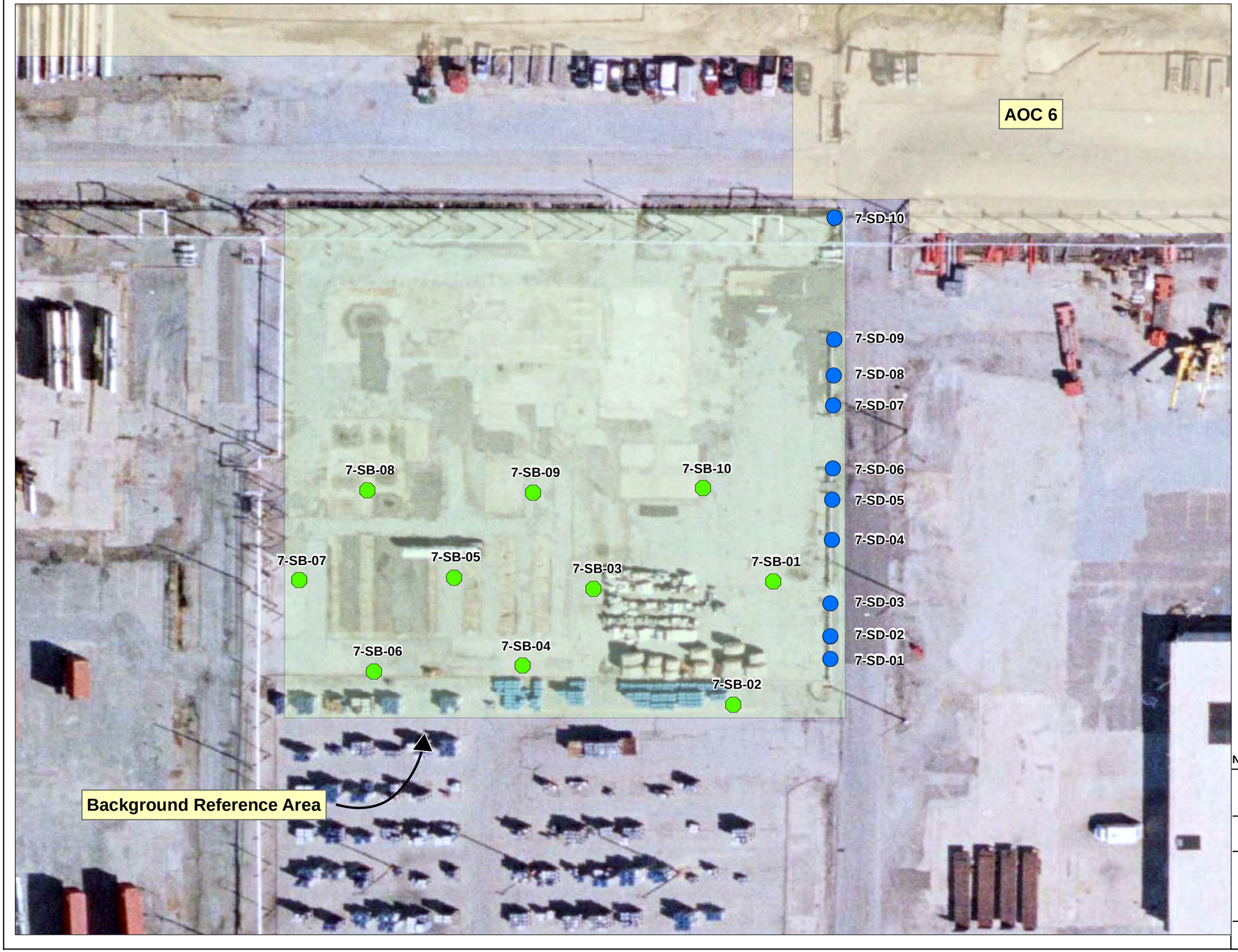
Location of Background Reference Area

SITEWIDE REMEDIAL INVESTIGATION
USACE - FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 9 - 1



N

Soil and Groundwater Sample Station Locations

Sediment and Surface Water Sample Station Locations

Background Reference Area

AOC 6

0 25 50 100 Feet

Note: Aerial Photo taken in September 2005

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Sampling Stations in the Background Reference Area

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USACE- FUSRAP
DuPont Chambers Works
Deepwater, New Jersey

June 2011 | Figure 9 - 2

APPENDICES

(On CD)

APPENDIX A

Ground Penetrating Radar (GPR) Data for Soils

APPENDIX B

Gamma Surveys

B-1: Gamma Walkover Surveys

B-2: Gamma Surveys (Downhole & Spectral)

APPENDIX C

Soil Logs & Well Construction Diagrams

C-1: Geoprobe Soil Logs
C-2: Cone Penetrometer Testing (CPT) Soil Logs
C-3: Subsurface Drilling Soil Logs & Well Construction Diagrams
C-4: Test Pit Logs – OU 1

APPENDIX D

Investigation Derived Waste Analytical Data

APPENDIX E

Air Quality Monitoring & Health/Safety Environmental Monitoring Records

APPENDIX F

Soils Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC)

APPENDIX G

Well Development Records and Water Level Measurement Forms

G-1: Piezometer Records

G-2: Monitoring Well Records

APPENDIX H

Groundwater Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC) and Chain of Custody Records (COCs)

H-1: Piezometer Data
H-2: Monitoring Well Data

APPENDIX I

Groundwater Elevation Contour Maps (Quarters 1-7)

APPENDIX J

Slug Test Data – OU 1 and 2

APPENDIX K

YSI Calibration Logs

APPENDIX L

Water Quality Data Figures & Isopleths (Quarters 1-6)

APPENDIX M

Quality Assurance/Quality Control Evaluation Results

APPENDIX N

Total Uranium Isopleth Maps (Quarters 1-6)

APPENDIX O

Ecological Site Visits, October 2003 and July 2007

APPENDIX P

Surface Water/ Sediment Analytical Data: Primary and Quality Assurance/Quality Control (QA/QC)

APPENDIX Q

Weather/Transducer Data OU 3

APPENDIX R

Soils Analysis Reports, USACE Waterways Experiment Station