EXPANDED TECHNICAL MEMORANDUM

Former Naval Air Station (NAS) Cape May, New Jersey
Formerly Used Defense Site (FUDS)
Project Number C02NJ0951

Contract Number: W912WJ-17-C-0014

Prepared for:

US Army Corps
of Engineers
New England District

United States Army Corps of Engineers
New England District
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LIST OF ACRONYMS AND ABBREVIATIONS

Amec	Amec Foster Wheeler Environment & Infrastructure, Inc.
AOC	Area of Concern
ASTM	American Society for Testing and Materials
Avatar	Avatar Environmental, LLC
BD/DR	Building Demolition and Debris Removal
bgs	below ground surface
Bluestone	Bluestone Environmental Group, Inc.
CEC	Cation Exchange Capacity
CENAE	USACE New England District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CON/HTRW	Containerized HTRW
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
DDD	4,4’-dichlorodiphenyldichloroethane
DDE	4,4’-dichlorodiphenyldichloroethylene
DDT	4,4’-dichlorodiphenyltrichloroethane
DoD	Department of Defense
DPT	Direct Push Technology
DQO	Data Quality Objective
e2M	engineering-environmental Management, Inc.
Eco-SSL	Ecological Soil Screening Level
EDR	Environmental Data Resources, Inc.
EM	Electromagnetic
EPA	Environmental Protection Agency
ERDC	Engineer Research and Development Center
FAA	Federal Aviation Administration
FOIL	Freedom of Information Law
FRTR	Federal Remediation Technologies Roundtable
ft	feet

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

ft/yr	feet per year
FUDS	Formerly Used Defense Sites
GIS	Geographic Information System
gpm/ft	gallons per minute per foot
GPR	Ground Penetrating Radar
GPS	Global Positioning System
GWQS	Groundwater Quality Standards
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HSDB	Hazardous Substances Data Bank
HTRW	Hazardous, Toxic and Radiological Waste
INPR	Inventory Project Report
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
mg/L	milligrams per liter
mm	millimeter
MMRP	Military Munitions Response Program
NAS	Naval Air Station
NAVD88	North American Vertical Datum 1988
NEA	Northern Ecological Associates, Inc.
NJDEP	New Jersey Department of Environmental Protection
NOAA	National Oceanic and Atmospheric Administration
OEW	Ordnance and Explosive Waste
Ogden	Ogden Environmental and Energy Services Company, Inc.
OPRA	Open Public Records Act
ORP	Oxidation Reduction Potential
OVA	Organic Vapor Analyzer

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PDT	Project Delivery Team
PETN	Pentaerythritol tetranitrate
POL	Petroleum, Oil, and Lubricants
RDX	1,3,5-trinitro-1,3,5-triazine (cyclonite, or “Royal Demolition Explosive”)
RI	Remedial Investigation
RSL	Regional Screening Level
sf	square feet
SIM	Selected Ion Monitoring
SLERA	Screening-Level Risk Assessment
SMCL	Secondary Maximum Contaminant Level
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
TCRA	Time Critical Removal Action
TNT	Trinitrotoluene
TOC	Total Organic Carbon
TRACENCM	Training Center Cape May
U.S.	United States
UAS	Unmanned Aircraft System
UCL	Upper Confidence Limit
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Bluestone Environmental Group, Inc. (Bluestone) has been tasked by the United States Army Corps of Engineers (USACE), New England District (CENAE) under contract W912WJ-17-C-0014, to conduct site background and historical records reviews and site visits for seven Formerly Used Defense Sites (FUDS) to determine the next steps toward completing investigations of contamination at the sites. The sites included under this contract (with corresponding FUDS Property Numbers) are:

- Stewart Air Force Base, New York (C02NY0704)
- Iona Island Naval Ammunition Depot, New York (C02NY0744)
- New York Ordnance Works, New York (C02NY0290)
- Fort Hancock, New Jersey (C02NJ0004)
- **Naval Air Station (NAS) Cape May, New Jersey (C02NJ0951)**
- Nike Antiaircraft Missile Battery BU 51/52, New York (C02NY0079)
- United States (U.S.) Naval Training Device Center, New York (C02NY0758)

Based on the results of the site background and historical records review and information gathered during the site visit, Bluestone prepared this Expanded Technical Memorandum for the former NAS Cape May (the Site), New Jersey (CO2NJ0951), specifically, the Hazardous, Toxic Radioactive Waste (HTRW) project (C02NJ095101).

1.1 Purpose and Scope

The purpose of this Expanded Technical Memorandum is to identify FUDS-eligible Areas of Concern (AOCs), provide a summary of historical documents and previous investigations, develop a preliminary site-specific Conceptual Site Model (CSM), identify data gaps, provide recommendations to address the data gaps, and develop a general approach for the risk assessments.

Documents reviewed for this Expanded Technical Memorandum included: i) reports, letters, and memoranda provided electronically by USACE and the site owner; and, ii) observations during the site visit. Freedom of Information Law (FOIL) requests to the local municipalities (City of Cape May and Cape May County, New Jersey) returned no available records. A New Jersey Open Public Records Act (OPRA) request also returned no records. No information was found for the Site during an online search of the New Jersey State Department of Environmental Protection (NJDEP) or U.S. Environmental Protection Agency (EPA) Region 2 websites.

1.2 Site Description and History

The Site is currently being operated as the U.S. Coast Guard (USCG) Training Center Cape May (TRACENCM) and is located in Cape May County, New Jersey, approximately 50 miles south of Atlantic City (as shown on the inset in **Figure 1-1**). The Site is bound to the west by residential areas; to the north by Cape May Harbor; to the east by Cape May Inlet; and to the south by the Atlantic Ocean. The Site is accessed from Pennsylvania Avenue in Cape May, New Jersey.

The U.S. Government obtained the 426.774-acre property through a deed dated 2 December 1918 and Declarations of Taking dated 16 July 1941 and 24 June 1942. The U.S. Navy operated the Site from 1918 to 1946 (USACE, 1994a and 1994b). In 1946, the U.S. Navy conveyed 426.774-acres fee to the USCG (USACE, 1994a and 1994b). According to the USACE Inventory Project Report (INPR) Site Survey Summary Sheet, "Since 1946, approximately 101.814 acres has been lost to erosion and other forces of nature" (USACE, 1994a).

Prior to use by the Navy, the oceanfront portion of the Site was used as an amusement park. After World War I, the Site was used for dirigible landing and storage. By 1924, the Site was used as a landing strip for planes used by the USCG for coastal patrols. In 1941, the airfield was expanded and the Site was used as a training base for Navy carrier pilots. The USCG also utilized the Site for coastal patrol, anti-submarine warfare, air/sea rescue, and buoy service [engineering-environmental Management, Inc. (e2M), 2003].

TRACENCM was established in 1948 (e2M, 2003). The USCG, part of the Department of Homeland Security, is the owner of record for the Site. The Training Center is the fifth largest USCG base, and is comprised of housing, offices, clinics, a chapel, shops, and a child development center (USCG, 2018).

1.3 Aerial Photograph Review

Aerial photographs for the years 1931, 1940, 1951, 1957, 1961, 1974, 1977, 1984, 1991, 1995, 2006, 2010, 2013, and 2017 for the Site were reviewed to determine changes in land use over time (**Table 1-1**). The scale of all photographs is 1 inch to 500 feet (ft). Copies of the aerial photographs are provided in **Appendix A**.

1.4 FUDS Eligibility

According to the INPR (USACE, 1994a), there were two potential projects at the Site, one for Ordnance and Explosive Waste (OEW) and one for HTRW. The OEW project included eleven ammunition bunkers, two firing ranges, and surrounding beaches, and is not listed in the online FUDS Inventory (USACE, 2015) as an open project. The eleven ammunition bunkers were used by the USCG after the property was transferred; thus, are not eligible for the FUDS program (USACE, 1994b). The two Former Firing Ranges were also listed for lead contamination under the HTRW project. No OEW incidents have occurred at or near the Site since 1970, when a fisherman found ordnance offshore. The Risk Assessment determined that risk for OEW at the Site was negligible (USACE, 1994b). The HTRW project included three potential AOCs: one Abandoned Dumping Station and the two Former Firing Ranges. Since this contract is for HTRW only, this Expanded Technical Memorandum only addresses the potential AOCs identified for the HTRW project.

USACE, Baltimore District, conducted a site inspection of the three potential HTRW AOCs. The original INPR (USACE, 1994a), Revised Site Survey Summary Sheet (USACE, 1994c), and Revised Project Summary Sheet (USACE, 1995a) are provided in **Appendix B**. **Figure 1-1** shows the locations of the three potential AOCs identified in the INPR.

1. AOC 1 – Abandoned Dumping Station. The Abandoned Dumping Station is located along the Cape May Inlet, approximately 600 ft northeast of the Former Eastern Firing Range and 750 ft due east of Arcus Road. Details regarding disposal history have not been found in the historical records, but Ogden Environmental and Energy Services Company, Inc. (Ogden) observed debris on the surface and within the cross-section of the eroded dump during their initial site reconnaissance (Ogden, 1998). Much of the estimated footprint of the Abandoned Dumping Station is now underwater, as shown on **Figure 1-1**.
2. AOC 2 – Former Eastern Firing Range. The Former Eastern Firing Range is located at the southeastern corner of the Site at the southern end of Arcus Road. This range was beneficially used by USCG from 1946 through 1992, including installation of a bullet trap. The USCG conducted a Time Critical Removal Action (TCRA) at this range in 2011 (Amec, 2015) to prevent the release of metals, especially lead, from leaching into the soil and groundwater.
3. AOC 3 – Former Western Firing Range. The Former Western Firing Range is located approximately 1,200 ft west of the Former Eastern Firing Range adjacent to the Atlantic Ocean beach. This range was also beneficially used by USCG after 1946, but has since been abandoned (Ogden, 1998); the date of the abandonment was not reported, but aerial photographs indicate some overgrowth as early as 1957. Much of this area has eroded.

As shown in **Table 1-2**, the Abandoned Dumping Station (AOC 1) is eligible for consideration under the FUDS HTRW Program (USACE, 2004) because: i) it is no longer owned or operated by the Department of Defense (DoD); ii) it was transferred from DoD prior to 17 October 1986; iii) it has not been altered or beneficially used by the current owner; iv) contamination does not post-date DoD use; v) restoration has not been initiated; and, vi) it is not currently addressed under the FUDS Military Munitions Response Program (MMRP), Building Demolition and Debris Removal (BD/DR), or Containerized HTRW (CON/HTRW) programs.

In contrast, the two Former Firing Ranges (AOC 2 and AOC 3) have both been beneficially used by the current owner, resulting in potential for contamination that post-dates DoD use (USACE, 2004). Remediation has also been conducted at AOC 2. Based on discussions with Ms. Erin Kirby (CENAE Project Manager), it is our understanding that CENAE is planning to modify the INPR to eliminate the two Former Firing Ranges (AOCs 2 and 3) as HTRW AOCs.

Therefore, AOC 1 - Abandoned Dumping Station is the only remaining HTRW FUDS-eligible AOC for inclusion in this Expanded Technical Memorandum. Previous investigations at the Former Firing Ranges are discussed in the following section since they are listed in the INPR, and to provide a more complete understanding of the Site.

2.0 RECORDS REVIEW/PREVIOUS INVESTIGATIONS

Previous environmental investigations have focused on the following areas of the Site:

- Abandoned Dumping Station
- Former Eastern Firing Range
- Former Western Firing Range

These areas are all located within the land area occupied by TRACENCM. The discussion of previous investigations is presented in the following subsections chronologically and by area.

2.1 Abandoned Dumping Station (*AOC 1 – HTRW FUDS-Eligible*)

AOC 1 is located north of the Former Eastern Firing Range along Cape May Inlet (**Figure 2-1**), and has experienced beach erosion, reducing the size of the land area. The following section summarizes the results of a previous investigation at AOC 1.

<u>Ogden Environmental and Energy Services Company, Inc. (Ogden), 1998</u>

In October 1997, Ogden conducted sampling at all three potential AOCs, on behalf of Northern Ecological Associates, Inc. (NEA), for USACE, New York District. The purpose of the investigation at AOC 1 was to evaluate the potential presence of toxic or hazardous materials in the soil and groundwater. Ogden collected and evaluated soil and groundwater samples (**Appendix C,** Figure 3-1) and compared the results to 1996 NJDEP Soil Cleanup Criteria and 1997 NJDEP Groundwater Quality Standards (GWQS), the most current criteria available at the time of the investigation. The sampling results are provided in **Appendix C**, Tables 4-3 through 4-10.

Eight soil samples were collected from four soil borings (DS-B1 through DS-B4) using a Geoprobe® drill rig (**Appendix C**, Figure 3-1). Soil samples were collected at two intervals per boring: shallow (0 - 2 foot interval) and deep (collected less than six inches above the water table). Groundwater samples were collected directly from two of the four boring locations (DS-B1 and DS-B3). The soil and groundwater samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) (EPA Method 8260), TCL semivolatile organic compounds (SVOCs) (EPA Method 8270), pesticides/polychlorinated biphenyls (PCBs) (EPA Method 8080), and Target Analyte List (TAL) metals (EPA Method 6010 and EPA Methods 7471 and 245.2 for mercury). The TAL metals samples were collected as both filtered (dissolved) and unfiltered (total) samples.

Ogden determined that no VOCs, SVOCs, pesticides, PCBs, or metals were detected at concentrations above comparison criteria in soil. No concentrations of VOCs, SVOCs, or PCBs were detected above laboratory detection limits in the groundwater samples and no laboratory detection limits exceeded comparison criteria. The groundwater sample (DS-B3-GW-01) collected from boring location DS-B3 contained the pesticide-related compounds 4,4'-dichlorodiphenyldichloroethylene (DDE) and 4,4'-dichlorodiphenyltrichloroethane (DDT) in concentrations exceeding the NJDEP GWQS [0.10 micrograms per liter (µg/L)], with concentrations of 0.13 µg/L and 0.16 µg/L, respectively. However, the duplicate sample (D3-B3-

GW-02) only exceeded the NJDEP GWQS for DDT, at a concentration of 0.11 µg/L (**Appendix C**, Table 4-9).

The NJDEP GWQS were exceeded for both total (unfiltered) and dissolved (filtered) iron, manganese, and sodium in groundwater samples from both borings (**Appendix C**, Table 4-10). Aluminum concentrations also exceeded the NJDEP GWQS in groundwater samples from both boring locations (total in DS-B1-GW-01; total and dissolved in DS-B3-GW-01 and duplicate D3-B3-GW-02). In groundwater sample DS-B3-GW-01, the concentrations of total chromium (230 µg/L), total lead (327 µg/L), and total nickel (129 µg/L) also exceed the NJDEP GWQS. Total arsenic also exceeded the NJDEP GWQS in groundwater sample DS-B3-GW-01 and duplicate DS-B3-GW-02 from boring location DS-B3. The concentrations of these metals in the dissolved samples were well below the NJDEP GWQS (and in some cases, were non-detect).

Ogden attributed the exceedances of iron and manganese in groundwater to the mineralogy of the surface sediments; of sodium to sea water mixing; and, of aluminum, chromium, lead, nickel, and arsenic to onsite disposal (Ogden, 1998).

2.2 Former Firing Ranges *(AOCs 2 and 3 – not HTRW FUDS-Eligible)*

USCG had renovated the Former Eastern Firing Range (AOC 2) and was still using the range when Ogden began their investigation in October 1997. The renovations included an enclosed firing room with an outdoor bullet trap, adjacent to the former berm, approximately 125 ft to the north of the beach.

The Former Western Firing Range (AOC 3) had already been abandoned by the time of the Ogden investigation. It was covered with dense vegetation, including poison ivy growth, and *Phragmites australis* (abbreviated as *Phragmites*, also referred to as “common reed”) coverage to the north. The berm for this range was approximately 100 ft south of the edge of the *Phragmites*, along the inland edge of the beach.

The locations of the two Former Firing Ranges are shown on **Figure 1-1**. The following sections summarize the results of previous investigations in these areas.

<u>Ogden, 1998</u>

The purpose of the investigation at the Former Firing Ranges was to determine the potential for lead contamination in soil and groundwater. Ogden collected and evaluated groundwater and soil samples from both ranges (**Appendix C**, Figure 3-2), and compared the results to the NJDEP soil cleanup criteria and NJDEP GWQS.

At the Former Eastern Firing Range (AOC 2), 30 surface soil [0 to 0.5 ft below ground surface (bgs)], two duplicate surface soil, and subsurface soil samples from three locations (at two depth intervals, 1.0 to 1.5 ft bgs and 2.0 to 2.5 ft bgs) were collected using hand augers. A Geoprobe® drill rig was used to collect groundwater samples for the analysis of filtered and unfiltered TAL metals from boring location FR1-B1 (located at shallow soil sample location FR1-HA22, on the south side of the berm near the centerline of the firing range). Twenty-four of the 38 soil samples at the Former Eastern Firing Range exceeded the NJDEP Residential Direct Contact Cleanup Criterion for lead [400 milligrams per kilogram (mg/kg)] in concentrations ranging from 428 mg/kg to 137,300 mg/kg for surface soil and 500 mg/kg to 34,600 mg/kg for subsurface soil (**Appendix C**, Table 4-1). The maximum concentration in surface soil (0 to 0.5 ft bgs) was 137,300 mg/kg at location FR1-HA23-01, on the south side of the berm near the centerline (**Appendix C**, Figure 3-2). The maximum concentration in subsurface soil was 34,600 mg/kg from location FR1-HA16-01, at a depth of 1 to 1.5 ft bgs. Groundwater exceedances for total metals at the Former Eastern Firing Range included aluminum (89,600 µg/L), arsenic (88.1 µg/L), chromium (538 µg/L), iron (224,000 µg/L), lead (413 µg/L), nickel (263 µg/L), and sodium (65,800 µg/L). For dissolved metals, only iron (2,210 µg/L), manganese (167 µg/L), and sodium (54,200 µg/L) exceeded criteria (**Appendix C**, Table 4-2).

At the Former Western Firing Range (AOC 3), 27 surface soil (0 to 0.5 ft bgs), two duplicate surface soil, and subsurface soil samples at three locations (at two depth intervals, 1.0 to 1.5 ft bgs and 2.0 to 2.5 ft bgs) were collected using hand augers. A Geoprobe® drill rig was used to collect groundwater samples for the analysis of filtered and unfiltered TAL metals from boring location FR2-B1 (located at shallow soil sample location FR2-HA12, in the central portion of the berm). Twelve of the 35 soil samples from the Former Western Firing Range exceeded the NJDEP Residential Direct Contact Cleanup Criterion for lead (**Appendix C**, Table 4-1). All of these exceedances were surface soil samples, with concentrations ranging from 511 mg/kg to 2,590 mg/kg. The maximum concentration was detected in the surface sample collected from location FR2-HA9-01 on the south side of the berm (**Appendix C**, Figure 3-2). Groundwater exceedances for total metals at the Former Western Firing Range included aluminum (35,000 µg/L), arsenic (32.4 µg/L), chromium (245 µg/L), iron (71,600 µg/L), lead (69.2 µg/L), manganese (696 µg/L), nickel (395 µg/L), and sodium (282,000 µg/L). Dissolved iron (1,200 µg/L), manganese (102 µg/L), nickel (474 µg/L), and sodium (256,000 µg/L) exceeded the NJDEP GWQS (**Appendix C**, Table 4-2).

Ogden concluded that there was residual lead contamination in soil at the Former Firing Ranges from previous activity, especially in soil within and adjacent to the former target berms.

<u>Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), 2015</u>
From October through December 2011, Amec Foster Wheeler, under contract to the USCG, conducted a Time Critical Removal Action (TCRA) at the Former Eastern Firing Range (AOC 2). The objective of the TCRA was to remove spent bullet-containing soil potentially contaminated with heavy metals. The Former Eastern Firing Range consisted of a semi-enclosed firing position surrounded by concrete block walls with vertical overhead baffles and a steel bullet trap. Amec Foster Wheeler excavated the target berm to a depth approximately equal to the surrounding surface level, covering an area of approximately 24,400 square feet (sf). An additional 2.5 ft of soil was removed from an adjacent area measuring 30 ft by 175 ft, due to the high

concentration of spent bullets found in the soil in this area. Approximately 9,310 tons of soil and associated plant material and debris were removed from the area and disposed offsite.

After the soil removal, test pits were excavated in the floor of the area, and samples collected in the test pit walls were sieved to determine spent bullet concentrations. Soil samples were collected from the floor of the excavation; samples were analyzed for total lead, total copper, total antimony, and total arsenic using EPA Method 6010B; these metals were associated with the presence of spent bullets in the soil. The remedial action objectives were the NJDEP Direct Contact Soil Remediation Standards (NJDEP, 2008) of 400 mg/kg for lead, 1,600 mg/kg for copper, 31 mg/kg for antimony, and 19 mg/kg for arsenic.

Based on the results of analysis, Amec Foster Wheeler concluded that total lead is the primary contaminant, and that future sampling will only require analysis for lead. Contaminated soil remains at the Former Eastern Firing Range beneath the footprint of the target berm. Spent bullets were present to a depth of 2.5 ft.

2.3 Summary

AOC 1 – Abandoned Dumping Station

Ogden collected eight soil samples from four borings and two groundwater samples from two borings and analyzed for TCL and TAL compounds. Ogden compared the results to NJDEP Soil Cleanup Criteria (1996) and NJDEP GWQS (1997). No soil cleanup standards were exceeded. In groundwater, GWQS were exceeded for pesticides (DDE and DDT) only in location DS-B3. Total and dissolved iron, manganese, and sodium exceeded the GWQS in both groundwater samples; total and dissolved aluminum exceeded standards in location DS-B3, and total chromium, lead, and nickel exceeded criteria in DS-B3.

Ogden attributed the exceedances of iron and manganese in groundwater to the mineralogy of the surface sediments; of sodium to sea water mixing; and of aluminum, chromium, lead, nickel, and arsenic to onsite disposal (Ogden, 1998).

AOCs 2 and 3 – Former Firing Ranges

Ogden collected 30 surface soil and six subsurface soil samples and one groundwater sample from the Eastern Firing Range and analyzed all samples for TAL metals. Results of analyses indicated that 24 of the 38 soil samples collected from the Eastern Firing Range exceeded the NJDEP soil cleanup criteria for lead. In groundwater, total metals concentrations that exceeded the GWQS included aluminum, arsenic, chromium, iron, lead, nickel, and sodium. Dissolved metals that exceeded criteria included iron, manganese, and sodium.

Ogden collected 27 surface soil samples and six subsurface soil samples, and one groundwater sample from the former Western Firing Range and analyzed all samples for TAL metals. Twelve of the 27 surface soil samples exceeded the criteria for lead; there were no exceedance of criteria for subsurface soil samples. In groundwater, the GWQS were exceeded for total aluminum, arsenic, chromium, iron, lead, manganese, nickel, and sodium. Criteria were exceeded for dissolved iron, manganese, nickel, and sodium.

Ogden concluded that there was residual lead contamination in soil at the Former Firing Ranges from previous activity, especially in soil within and adjacent to the former target berms. Ogden attributed exceedances of criteria for sodium in groundwater to seawater mixing. Exceedances of iron and manganese were attributed to mineralogy of the underlying geologic formation, and exceedances of criteria for aluminum, arsenic, chromium, lead, and nickel were attributed to former firing range activities (Ogden, 1998).

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3.0 SUMMARY OF SITE VISIT

Representatives from CENAE, Bluestone, and Avatar Environmental, LLC (the team) met with Mr. Chris Hajduk (TRACENCM, Environmental Protection & Safety Section) in the Administration Building on the morning of October 10, 2018. LT Robison (Chief of the Maintenance Branch) also briefly introduced himself to the team. Photographs from the site visit are provided in **Appendix D**.

USACE began the meeting with introductions and a brief overview of the project. Mr. Hajduk then provided general background on each of the potential AOCs and led the team on a site tour. All three AOCs have limited access, with restrictions and signs. There is no public access and no anticipated changes to land use.

Notes from the meeting and observations during the site visit are summarized below by AOC:

- Abandoned Dumping Station (AOC 1) – Located along the eastern shoreline, the Abandoned Dumping Station is predominantly underwater due to substantial shoreline erosion in this area. Mr. Hajduk said that about 15 years ago, he observed silverware, coins from the 1940s, and general debris along the shoreline in this area. However, in recent years he has only seen modern debris that has washed ashore from the ocean. Mr. Hajduk stated that the entire Abandoned Dumping Station is saturated with ocean water two times a day at high tide and floods (over the road) up to ten times per year due to storm surges and astronomical high tides (or "king tides"). The only hazardous wastes he suspects could have been dumped in this area are potentially buried drums.

  During the site walk at AOC 1, the only debris observed along the beach was plastic ocean trash and concrete/rebar (most likely construction debris, historically used as shoreline protection). Horseshoe crab shells and dried seagrass were also visible on the beach (**Appendix D**, **Photograph 7**). The exposed portion of the landfill is approximately one acre in size and is dominated by invasive plant species like ragweed, goldenrod, and *Phragmites*. Avian species observed in this area during the visit included: seaside sparrows, laughing and herring gulls, red-winged blackbirds, and starlings.

  While at AOC 1, Mr. Hajduk mentioned that the USCG installed metal sheet piling along the edge of the security road, in the vegetated area of the shoreline between the perimeter road adjacent to AOC 1 and the beach, to protect the integrity of the road from shoreline erosion. The sheet piling was installed to a depth of 25 ft bgs. The top of the sheet piling (**Appendix D**, **Photographs 9 and 10**) was visible during the site visit. No unexploded ordnance (UXO) was encountered during the installation of the sheet piling (Hajduk, 2018).

- Former Eastern Firing Range (AOC 2) – The Former Eastern Firing Range is located on the southern shoreline of the Site. The earthen berm associated with this range was beneficially used by the USCG from 1946 until 1992, when a bullet trap was installed. Mr. Hajduk explained that the USCG conducted a TCRA for approximately $1.1M from October to December 2011. The berm and impacted soils were removed to a depth of approximately 2.5 ft bgs. A total of approximately 9,310 tons of soil and debris were removed, treated onsite to reduce lead concentrations, and disposed as non-hazardous waste. The soil was treated mechanically to remove metal particles, using a vibrating screen, then treated chemically using TerraBond® to reduce the lead results to acceptable TCLP levels. Post-excavation confirmation sampling was conducted, the area was then backfilled with clean soil, and restored (Amec, 2015). In 2012, the range was completely demolished by the USCG and is currently being used by the Navy as a Radar test facility. The USCG is considering constructing a fully-enclosed firing range in the area of AOC 2 for an estimated $10M-$15M.

  Mr. Hajduk mentioned that during the TCRA, oxidized bullets were found that were estimated to be greater than 50 years old. The bullets found were predominately 5.56 millimeter (mm) M16 rounds (used by the USCG), 45 mm rounds (used by the USCG and Navy), and 7.62 mm M1 Rounds (used by both the USCG and Navy).

  During the site walk, it was noted that the two firing range areas are overgrown with vegetation, including *Phragmites* and poison ivy. However, at AOC 2, the area where the radar components have been installed appears to be routinely maintained. The radar components were not photographed. The features of the firing range have been removed.

- Former Western Firing Range (AOC 3) – This AOC was a long-range firing range, with an earthen berm, utilized beneficially by the USCG after 1946. This area, also located adjacent to the southern shoreline, has been impacted by significant erosion. USACE conducts a beach replenishment (sand) project every two years along the southern shoreline.

  Bullets have been found on the beach and caught up in the Meadow Mat (**Appendix D, Photograph 27**) several feet below the overlying sand near AOC 3. The Meadow Mat is a buried marsh consisting of peat and organic silt that formed in saltmarshes and estuaries during the Holocene sea level rise. This Meadow Mat was subsequently overlain with beach, dune, nearshore, overwash, and tidal delta deposits. The organic material and silt form a tighter unit that, unlike the overlying sand, does not allow the bullets to migrate deeper into the subsurface. Mr. Hajduk indicated that USCG staff periodically picked up bullets along the beach; however, bullets have not been seen in several years. He offered to forward a photograph of bullets previously found on the beach (**Appendix D, Photograph 33**).

The remains of a concrete bunker (**Appendix D**, **Photographs 25 and 26**) were observed off of the southern shoreline between AOCs 2 and 3 (Former Eastern and Western Firing Ranges). Mr. Hajduk remarked that a Meadow Mat is present below the bunker, at a depth of about 6 ft bgs. There was no debris observed along the beach in this area.

As noted above, vegetation at both firing ranges is dominated by *Phragmites* (**Appendix D**, **Photograph 21**). Lower ground vegetation frequently observed included: Johnson grass, sheep sorrel, curly dock, bitter panic grass, and beach grass. Trees and shrubs observed in varying densities included: Japanese honeysuckle, bayberry, red cedar, pitch pine, and crepe myrtle.

After the site visit, Mr. Hajduk forwarded Bluestone electronic copies of the Final Removal Action Completion Report (Amec, 2015) for the TRCA and an electronic copy of the Integrated Natural Resources Management Plan and Environmental Assessment (e2M, 2003).

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4.0 PHYSICAL CHARACTERISTICS

The Site is in the Coastal Plain Physiographic Province. This province is characterized by a low, gently to moderately rolling land surface and low relief. Elevation at the Site ranges from 0 ft North American Vertical Datum of 1988 (NAVD88) at the shoreline to approximately 15 ft NAVD88 in the area between the harbor and the ocean.

4.1 Meteorology

Based on a three-decade average of climatological data (“1981-2010 Climate Normals”) for Cape May, New Jersey, the average minimum temperature for the region is 27.9°F in January and average maximum temperature is 84.5°F in July. Precipitation averages 41.88 inches annually, relatively evenly distributed during the year [National Oceanic and Atmospheric Administration (NOAA), 2018].

4.2 Surface Water Drainage

Surface water runoff at the Site follows topography to the south, north, and east. Surface water flows southward to the Atlantic Ocean, northward to Cape May Harbor, and eastward to Cape May Inlet (**Figure 1-1**). No streams were observed at the Site.

4.3 Geology

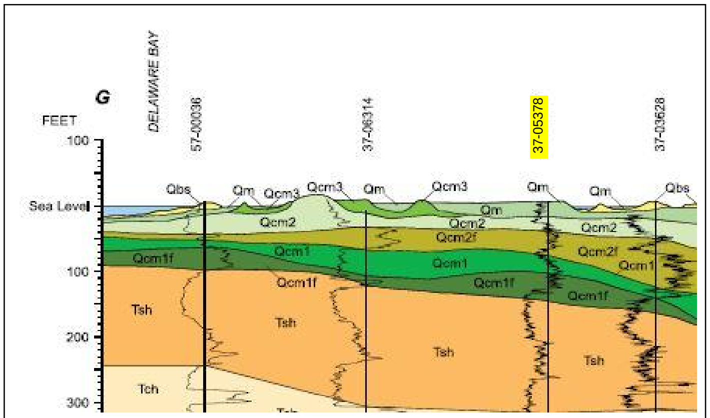
The geology of the Site consists of coastal plain deposits, with beach sands and dunes overlying interbedded estuarine and marsh deposits.

Source: Sugarman, et al. (2016)

Sugarman, et al. (2016) used a well located at the Site (NJ Well ID 37-05378, identified on the figure to the right) in their cross-sections of southern Cape May County. This well is located west of the intersection of Munro Avenue and Arcus Road. This Geologic and Aquifer Map is contained in **Appendix E;** NJ Well ID 37-05378 is shown on cross-section G-G’. The well log indicates 10 ft of beach, dune, shoreface, overwash fan, and tidal delta deposits over 20 ft of salt marsh and estuarine deposits. Pieces of the salt marsh deposits (“Meadow Mat”, comprised of peat and organic silt) were found during the site visit on the beach near the Former Eastern Firing Range (AOC 2) (**Appendix D, Photograph 27**). As sea level rises and the beach, dune, and overwash sand deposits are eroded, buried marsh deposits are exposed at the shoreline. These marsh deposits are eroded and carried by high tides, storm surges, and overwash processes that are deposited on the surface further inland.

From oldest (deepest) to youngest (shallowest), the geologic units present at the Site (illustrated in the figure below) are as follows:

The Stone Harbor Formation (140 ft thick) contains three depositional environments: a medium- to coarse-grained quartz sand with very coarse, pebbly beds; a lignitic sandy clay, and an organic-rich sand silt with organic brown clay (Sugarman, et al., 2016). These units are Tertiary deposits and represent estuarine and nearshore environments. The surface of this unit is greater than 100 ft below ground surface (Sugarman, et al., 2016).



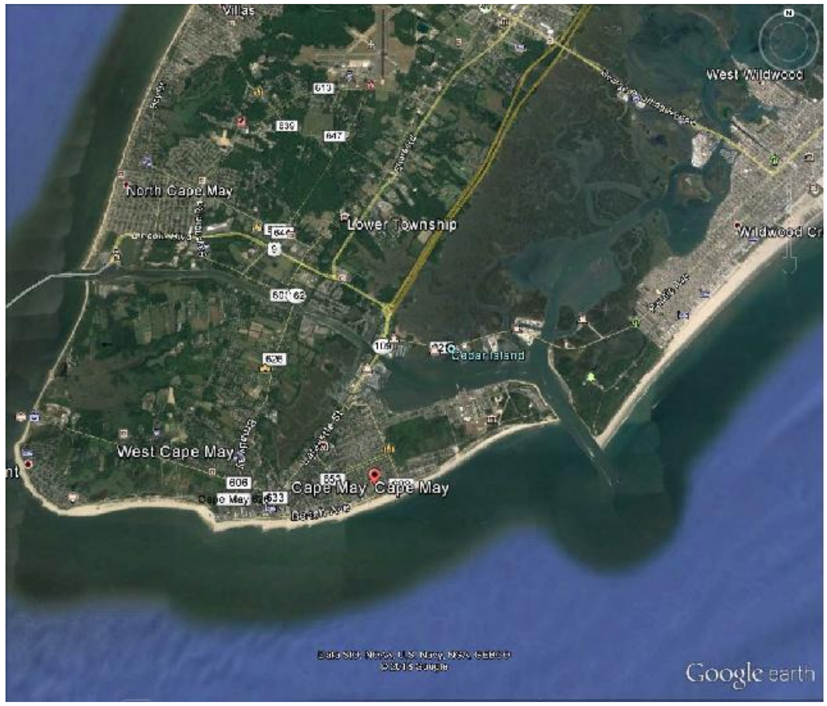
Source: Sugarman, et al. (2016)

Approximately 15 ft of the Late Pleistocene Cape May Formation, Unit 1 overlies the Stone Harbor Formation. This unit consists of sand and pebble gravel (Qcm1), and silt, clay, and fine sand (Qcm1f). The sand and pebble gravel were deposited in beach, dune, shoreface, overwash fan, and tidal delta environments, and the silt, clay, and fine sand were deposited in estuarine and bay environments (Sugarman, et al., 2016).

Cape May Formation Unit 1 is overlain by Cape May Unit 2. This unit consists of sand and pebble gravel (Qcm2) and silt, clay, and fine sand (Qcm2f). The sand and pebble gravel were deposited in beach, dune, shoreface, overwash plain, tidal delta, and fluvial-estuarine environments. The silt, clay, and fine sand were deposited in estuarine and bay environments (Sugarman, et al., 2016).

Cape May Formation Unit 1 is overlain by Holocene sand, silt, clay, and peat. The sand forms the beaches and dunes and the fine sand, silt, clay, and peat forms salt marshes (Sugarman, et al., 2016). The mineralogy of the beaches and dunes includes silica sand as well as heavy minerals, of which 42% is horneblende (McMaster, 1954). Horneblende contains calcium, sodium, magnesium, iron, aluminum, and silica, which may affect soil and groundwater sampling results. The beach and dunes sands also include 10% garnet and smaller amounts of hypersthene, epidote, apatite, and diopside. These lesser components may contribute calcium, magnesium, iron, manganese, vanadium, and phosphorus to analytical results (McMaster, 1954). The Meadow Mat is a low permeability, discontinuous, semi-confining unit, due to the silt, clay, and organic material constituents; it is not an aquitard, however, and surface spills may infiltrate through the unit over time (Sugarman, et al., 2016).

Throughout the Quaternary, sandy and fine layers were deposited in alternating sequences as a result of transgressive and regressive seas. As a result, when sea level was higher, shallow water depositional features were replaced with deeper water features, the shallow water features migrated inland. The sandy units deposited during this period are the current aquifer units.



Coastal erosion has affected the Site in that original features of the Abandoned Dumping Station and the two former Firing Ranges are closer to the beach than when originally constructed.

Measurements of erosion on aerial photos indicate that the inlet shoreline at the Abandoned Dumping Station (AOC 1) has eroded approximately 100 ft, and the Atlantic Ocean shoreline has eroded approximately 450 ft at the Former Eastern Firing Range (AOC 2) and 400 ft at the Former Western Firing Range (AOC 3) since 1931. On average, the approximate rate of erosion is 1.15 feet per year (ft/yr) for AOC 1, 5.2 ft/yr at AOC 2, and 4.6 ft/yr at AOC 3. Much of the erosion likely occurred during storm events, although rising sea level may contribute to annual average rate of erosion. The direction of littoral movement of sand along the Site shoreline is from northeast to southwest. North of the inlet, littoral sediment movement is southward where it becomes trapped by the groin extending from the north side of Cape May Inlet (shown on the above figure). As a result of this trapping of sediment, the land north of the inlet extends nearly 2,000 ft further seaward than the Site, which is located south of the inlet. A second groin extended into the ocean from a point on the south side of the inlet further inhibits deposition of sediment along the Site shoreline. Continued sea level rise, estimated at 3 mm per year (Stanley et al., 2004), and increases in storm damage (including hurricanes and nor'easters) are likely to continue or to increase the rate of erosion at the Site.

4.4 Hydrogeology

During the previous investigation, groundwater was encountered at less than 4 ft bgs in the four borings at the Abandoned Dumping Station. Groundwater flows toward local water bodies to the north, east, and south (Ogden, 1998), including Cape May Harbor, Cape May Inlet, and the Atlantic Ocean. The Meadow Mat beneath the surficial sand is found at a depth of approximately 10 ft bgs. This unit is semi-confining and may act as an aquitard, reducing the amount of water that can infiltrate to the underlying Pleistocene units. The underlying

Pleistocene Cape May Formations 1 and 2 consist of estuarine sands and may also be considered an aquifer (Sugarman, et al. 2016).

The surficial aquifer at the Site is the Holly Beach Aquifer, which is approximately 35 ft thick and is found between 15 and 50 ft bgs (Sugarman, et al., 2016). The Holly Beach Aquifer is co-relative with the Quaternary deposits discussed in **Section 4.3**. In Cape May County, this aquifer supplies water mostly for domestic and irrigation uses. Approximately 5 percent of the water supply for Cape May County is derived from this unit. Aquifer tests conducted for the Holly Beach Aquifer in Middle Township, Cape May County, located north of the Site were found to have specific capacities between 5 and 7 gallons per minute per foot (gpm/ft). The transmissivity was 1,312 sf per day and the storativity was 4.26×10^{-4} (Sugarman, et al., 2016). Sugarman, et al. (2016) indicated that wells screened in this unit should be located away from bays and tidal creeks, as chlorides from salt water may adversely impact this aquifer. The Meadow Mat located above the Holly Beach Aquifer at the Site may attenuate the movement of overflow water from the tidal inlet or the ocean, but continued pumping in this unit at the Site would likely result in deterioration of water quality.

The Estuarine Sand Aquifer is beneath the Site at a depth of 130 to 210 ft. Wells tests conducted in this unit in Cape May County indicated a specific capacity of 9 gpm/ft. Concentrations of chloride and sodium in this unit exceed drinking water standards (Sugarman, et al., 2016). The primary water supply for the Site and local community is provided by the City of Cape May water utility from deep wells screened in the Cohansey and Kirkwood aquifers (at approximately 300 to 800 ft bgs) (Ogden, 1998). This aquifer is co-relative with the Tertiary Stone Harbor Formation.

4.5 Ecology

The Cape May peninsula is located between the Delaware Bay and the Atlantic Ocean and thus has 60 more frost-free days than northern Cape May County. This results in species common in the southern states. Tree species such as swamp chestnut oak (*Quercus michauxii*) and loblolly pine (*Pinus taeda*) are present in the lower peninsula [U.S. Fish and Wildlife Service (USFWS), 2006].

Ruderal (vegetation growing on a waste area where natural vegetation has been disturbed), forested, beach, dune, and wetland plant communities are present at the Site. Ruderal plant communities are located along disturbed areas such as roads, lawns, and dumps. Plants associated with ruderal areas include the common reed (*Phragmites australis)*, an invasive plant found in disturbed areas. Other ruderal plants include Johnson grass (*Sorghum halapense*), Japanese honeysuckle (*Lonicera japonica*), bull thistle (*Cirsium vulgare*), sheep sorrel (*Rumex acetosella*), cat's-ear (*Hypochoeris radicata*), and curly dock (*Rumex crispus*). In the wetland environments, saltmeadow hay (*Spartina patens)* and black-grass (*Juncus gerardii)* are also found (e2M, 2003; Dames & Moore, 1994).

Forested plant communities at the Site consist of red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), pitch pine (*Pinus rigada*), and red cedar (*Juniperus virginiana*) as well as fire cherry (*Prunus pennsylvanicum*), Carolina rose (*Rosa carolina*), blackberry (*Rubus* sp.), black willow (*Salix nigra*), sassafras (*Sassifras albidum*), and willow oak (*Quercus phellos*) (e2M, 2003).

Beach plant communities include American searocket (*Cakile dentula*), coast-blite goosefoot (*Chenopodium rubrum*), and beach-heath (*Hudsonia tomentosa*) (e2M, 2003). As mentioned previously, USACE conducts a beach replenishment project every two years along the southern shoreline that includes beach fill (sand) (USACE, 2018).

Dune plant communities include beachgrass (*Panicum amarum*), bitter panic grass (*Panicum amarulum*), American beachgrass (*Ammophila breviligulata*), American wormseed (*Chenopodium ambrosioides*), seaside goldenrod (*Solidago sempervirens*), bayberry (*Myrica pennsylvanica*), and black cherry (*Prunus serotina*) (e2M, 2003; Dames & Moore, 1994).

Wetland plant communities at the Site have been severely overtaken by common reed (*Phragmites australis)*. In some small areas, other grasses, including *Spartina* grasses and *Salicornia* glassworts are present (e2M, 2003).

The Cape May peninsula is a migratory corridor for birds, primarily due to the large horseshoe crab population along the western shoreline and the configuration of the land between the Delaware Bay and the Atlantic Ocean. This corridor attracts birds that eat horseshoe crab eggs, such as sharp-skinned hawk (*Accipiter striatus*), osprey (*Pandion haliaetus*), northern harrier (*Circus cyaneus*), and many species of owls, as well as the red knot (*Calidris canutus*, a candidate for Federal listing), least sandpiper (*Calidris minutilla*), dowitcher (*Limnodromus* spp.), and ruddy turnstone (*Arenaria interpres*) (USFWS, 2006). The beach at AOC 1 is a known nesting area for horseshoe crabs.

The Cape May peninsula is home to rare species including 27 birds, two mammals, three amphibians, four reptiles, 30 invertebrates, and 147 plants. The following are some of endangered, threatened, or rare species in the vicinity of the Site (USFWS, 2006; e2M, 2003):

<u>*Animals:*</u>

- Bald eagle (*Haliaeetus leucocephalus*) – Federally listed threatened and State listed as endangered
- Piping plover (*Charadrius melodus*) – Federally listed threatened and State listed as endangered
- Black skimmer (*Rynchops niger*) – State listed as endangered
- Least tern (*Sterna antillarum*) – State listed as endangered
- Yellow-crowned night-heron (*Nyctanassa violacea*) – State listed as threatened
- Black-Crowned Night-Heron (*Nycticorax nycticorax*) – Stated listed as threatened
- Roseate tern (*Sterna dougallii*) – Federally listed as endangered

Portions of the beach along the southern shore of the Site are closed seasonally, to protect the nesting habitats of the Piping Plover and Least Tern. However, this portion of the beach is distant from the Abandoned Dumping Station (Ogden, 1998).

Plants:

- Seabeach amaranth (*Amaranthus pumilus*) – Federally listed as threatened

Additional details regarding the threatened and endangered species on or in the immediate vicinity of the Site are provided in the *Integrated Natural Resources Management Plan and Environmental Assessment, USGC Training Center, Cape May, New Jersey* (e2M, 2003).

4.6 Wetlands

According to the National Wetlands Inventory Map managed by the USFWS, most of the undeveloped portion of the Site (approximately 49 acres) consists of palustrine freshwater emergent wetland. This wetland is characterized by trees, shrubs, and persistent emergent vegetation that are present for most of the year. The area is seasonally flooded, with surface water remaining for at least one month. When the surface is not flooded, the substrate is saturated at or near the surface (USFWS, 2018).

The freshwater forested/shrub wetland (approximately 6 acres) located along Arcus Road north of the Former Eastern Firing Range (AOC 2). This wetland is characterized by continuously saturated substrate with woody vegetation no more than 20 ft tall, such as shrubs and saplings. The vegetation has wide, flat leaves that are shed during cold or dry seasons (USFWS, 2018).

Estuarine and marine wetlands are present along the northeastern (approximately 2 acres) and southeastern (approximately 4 acres) corners of the Site. These wetlands are characterized by water salinity greater than 30 parts per thousand with little to no dilution and a substrate that floods with high tide, though the surface does not always flood. Only about 30 percent of the area is vegetated (USFWS, 2018); the remaining 70 percent has been developed by the USCG as roads, buildings, parking lots, and maintained lawns.

A map illustrating wetland areas at the Site is presented in **Appendix F.**

4.7 Land Use and Demography

The Site, which is situated in the town of Cape May, is zoned G1 for government use. The Site is bound on the north, east, and south by water, and on the west by residential housing districts and a dune stabilization district (City of Cape May, 2008). Demographics for Cape May indicate a population of 3,535 with a median family income of $57,877 (City-data.com, 2018).

Within the Site, land use includes:

- Open Space – 104 acres;
- Improved Areas (mostly north central) – 61 acres;
- Forested Areas (mostly eastern portion) – 46 acres;
- Outdoor Recreational Areas (southwest portion) – 27 acres;
- Sensitive Species (beaches and dunes along southern boundary) – 11 acres;
- Residential Areas – 1.2 acres;
- Roads/Impervious Surfaces – 47 acres; and,
- Wetlands – 27 acres (e2M, 2003).

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5.0 PROBLEM FORMULATION

The Problem Formulation incorporates a description of the site setting, a history of site use, contaminants known or expected to be present, and fate and transport processes expected to by active for those contaminants in the existing environment. Using this information, the final product of the Problem Formulation is the CSM that describes how receptors are likely to be exposed to contaminants of concern.

As defined in USACE Engineer Manual 200-1-12 - *Environmental Quality, Conceptual Site Models* (USACE, 2012a), a CSM describes sources of contamination, as well as complete, potentially complete, or incomplete human and ecological exposure pathways; current, determined, or reasonably anticipated future use of property; and, human and ecological potential receptors (USACE, 2012a). A CSM is an iterative planning and communication tool that provides a structure to summarize and display information and to identify additional information needed to develop technically sound decisions.

The following information was used to develop the preliminary CSMs for human health and ecological exposures.

5.1 Potential Source Area

As discussed in **Section 1.4**, the Abandoned Dumping Station (AOC 1) is the only HTRW FUDS-eligible AOC at the former NAS Cape May. The area within the red boundary for the Abandoned Dumping Station shown on **Figure 2-1**, was estimated in our Geographic Information System (GIS) as 2.12 acres. Approximately half of this area is now underwater due to shoreline erosion.

There was no evidence of the Abandoned Dumping Station (AOC 1) on the 1931 aerial photograph. However, the 1940 aerial photograph appeared to show activity within the area. Items were present offshore north of the Abandoned Dumping Station (AOC 1), which appeared to be larger than drums but were not clearly defined. There were no aerial photographs available from Environmental Data Resources, Inc. (EDR) for the early- to mid-1940s, near the time of property transfer. By 1951, the Dumping Station appeared inactive, but a debris fan was visible off of the eastern shoreline, suggesting that erosion was occurring. The historical aerial photographs are provided in **Appendix A**.

Details regarding disposal history were not found in the historical records provided by USACE or USCG. No additional disposal or spill records were found through FOIL requests to local municipalities (City of Cape May and Cape May County, New Jersey), a New Jersey OPRA request, or online searches of the NJDEP and EPA Region 2 websites. During the site visit, USCG personnel indicated that municipal-type waste and general debris have been observed over the years along the shoreline. The potential for historical disposal of drums was also mentioned by USCG personnel.

NAS Cape May was operated by the Navy from 1918 to 1946. The property was transferred to the USCG in 1946. Based on typical operations at military facilities, chemicals that may have been used on the Site and potentially disposed at the Abandoned Dumping Station (AOC 1) include: solvents; petroleum, oil, and lubricants (POL); fuel oils; and, metallic debris. There were also eleven ammunition bunkers located on-site, which were retained for beneficial use by the USCG after the property was transferred in 1946. While these bunkers are not considered AOCs for this FUDS HTRW project, the storage of ammunition at the facility suggests that items containing explosives-related compounds may also have been disposed at the Abandoned Dumping Station (AOC 1).

5.2 Contaminant Fate and Transport

As discussed in **Section 5.1**, very little is known about the nature and extent of the waste materials dumped or buried at the Abandoned Dumping Station (AOC 1). The following subsections describe how contaminants could have been released to the environment.

5.2.1 Identification of Contaminants of Potential Concern

For the purposes of this Technical Memorandum, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidance, historical data were compared to the following current EPA standards in **Tables 5-1 and 5-2**:

- National Primary Drinking Water Regulations – Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs), dated May 2009
- EPA Regional Screening Levels (RSLs) – Residential Soil, Industrial Soil, and Tap Water, dated May 2018
- EPA Ecological Soil Screening Levels (Eco-SSLs) – Interim Final, dated February 2005 through April 2008

It is understood that MCLs and tap water RSLs are very conservative values for groundwater that is not being used as a potable source. However, there are no other comparison criteria available for construction worker direct contact, which is the scenario being considered in the Human Health Risk Assessment.

Ogden sampled soil and groundwater at AOC 1 for VOCs, SVOCs, pesticides, PCBs, and metals. **Table 5-1** presents the soil data and **Table 5-2** presents the groundwater data (Ogden, 1998), compared to the criteria listed above.

VOCs

Low levels of methylene chloride were detected in soil, but were also present in the laboratory blanks, indicative of possible laboratory contamination. All of the methylene chloride detections were well below current EPA industrial soil RSLs. Eco-SSLs and regional background values do not exist for this compound. Toluene was the only VOC detected in groundwater, at an estimated concentration in one sample, well below the current MCL and tap water RSL.

VOCs may have been released during dumping or disposal activities at AOC 1, in waste solvents and paints, or petroleum-related compounds (including used motor oil, hydraulic oil, and transformer fluid). However, VOCs are unlikely to persist in the sandy, near shore-environment at AOC 1. VOCs have not been retained as contaminants of potential concern (COPCs), but may be added to the proposed analytical suite, if drums are suspected based on the outcome of the proposed geophysical surveys.

<u>SVOCs</u>

SVOCs [primarily polycyclic aromatic hydrocarbons (PAHs)] were detected below screening criteria in the soil samples collected at AOC 1. SVOCs were not detected in the groundwater samples. PAHs are ubiquitous in nature, formed as products of incomplete combustion from natural combustion sources (such as brush fires) or man-made combustion sources (coal and oil-fired equipment) (Abdel-Shafy and Mansour, 2016). Due to the unknown nature of the waste disposed at AOC 1, SVOCs have been retained as soil and groundwater COPCs.

<u>Pesticides</u>

Soil samples in AOC 1 contained low levels of DDT, 4,4’-dichlorodiphenyldichloroethane (DDD), and DDE. Detected soil concentrations ranged from 0.0011 mg/kg to 0.0440 mg/kg, Comparisons of Ogden (1998) soil data with current EPA RSLs and Eco-SSLs indicate that that the pesticides DDE (0.0440 mg/kg) and DDT (0.0410 mg/kg) collected from location B-4 exceeded the Eco-SSL of 0.021 mg/kg for each pesticide. Higher concentrations were observed in the shallow soil sample (0 to 2 ft bgs), suggesting historical use rather than disposal.

DDE and DDT were detected in groundwater, ranging from 0.000095 milligrams per liter (mg/L) to 0.00016 mg/L. Comparisons of Ogden (1998) groundwater data with current EPA MCLs and tap water RSLs indicated only exceedances of DDE. The tap water RSL was exceeded for DDE (0.00005 mg/L) in the groundwater sample collected from well B-3, with a concentration of 0.000130 mg/L.

The presence of DDT and its breakdown products (DDD and DDE) at low levels in soil is likely due to site use in accordance with manufacturer instructions; however, spent or off-spec containers of pesticides may have been disposed in the Abandoned Dumping Station (AOC 1). Therefore, the pesticide DDT and its breakdown have been retained as soil and groundwater COPCs for AOC 1.

<u>PCBs</u>

PCBs were not detected in soil or groundwater samples collected by Ogden at AOC 1. There is no documentation supporting the disposal of historical transformers containing oils contaminated with PCBs at AOC 1. Therefore, PCBs have not been retained as soil or groundwater COPCs for AOC 1.

Explosives

Explosives were not included in the original analytical suite by Ogden at AOC 1, but due to the proximity to the former ammunition bunkers, containers contaminated with explosives compounds may have been disposed at the Abandoned Dumping Station (AOC 1). Explosives commonly used from World War I through World War II included ammonium picrate, trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), 1,3,5-trinitro-1,3,5-triazine [also known as cyclonite, or "Royal Demolition Explosive" (RDX)], and powdered aluminum. These types of explosives are likely to have degraded over time in the near-shore environment at AOC 1. Explosives compounds have been retained as soil and groundwater COPCs for AOC 1, due to the unknown nature of the waste dumped in the area and the fact that explosives were not previously evaluated.

Metals

Prior dumping/disposal may be the cause of the elevated concentrations of metals in groundwater; however, the metals concentrations in soil were all below RSLs and Eco-SSLs.

In groundwater sampling location DS-B1, total (unfiltered) metals aluminum, iron, and sodium exceeded the MCL only; total arsenic exceeded only the RSL; and total manganese exceeded both the MCL and the RSL. Dissolved (filtered) metals that exceeded criteria in location DS-B1 include iron and sodium that exceeded only the MCL, and manganese that exceeded the MCL and the RSL. In the sample for location DS-B3, the MCL only was exceeded for total sodium; the RSL only was exceeded for total cobalt, and both the MCL and RSL were exceeded for total aluminum, arsenic, cadmium, chromium, iron, lead, and manganese. Dissolved metals exceedances in well DS-B3 include aluminum, iron, and sodium, which exceeded only the MCL; arsenic, which exceeded only the RLS; and manganese, which exceeded both the MCL and the RSL. The higher concentrations of metals in the total (unfiltered) samples may be due to the presence of suspended solids in the groundwater samples collected from the Geoprobe® borings.

Nickel was discussed by Ogden as exceeding the 1997 NJDEP GWQS, but it was not detected above current EPA groundwater criteria; thus, has not been selected as a groundwater COPC.

Sodium is likely present due to saltwater intrusion and is also considered an essential nutrient of low human toxicity; therefore, has not been retained as a groundwater COPC. The exceedances of sodium, iron, and manganese may also be attributed to seawater mixing and native formation mineralogy (Ogden, 1998). However, iron may also be present due to buried metallic debris.

Metals (including aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, manganese, and mercury) have been retained as groundwater COPCs. Due to their presence in groundwater, metals have been retained as soil COPCs.

Summary of Identified COPCs

Based on this screening, the following COPCs were identified for the Abandoned Dumping Station (AOC 1):

Media	Potential Site Contaminants	Status
Soil	VOCs – low level detections of methylene chloride (below current industrial soil RSLs), likely due to laboratory contamination	VOCs not retained as COPCs for soil, but may be reconsidered for the Remedial Investigation (RI) analytical suite, if drums are located during the geophysical surveys
	SVOCs – several PAHs detected in soil, but below screening criteria	SVOCs (limited to PAHs) retained as COPCs for soil
	Pesticides – DDT and DDE (above Eco-SSLs)	Pesticides retained as COPCs for soil
	PCBs – not detected in previous soil samples; no records suggesting the disposal of old transformers at AOC 1	PCBs not retained as COPCs for soil
	Explosives – not analyzed during the previous investigation at AOC 1; however, due to proximity to the former ammunition bunkers, containers contaminated with explosives compounds may have been disposed at AOC 1	Explosives retained as COPCs for soil
	Metals – detected below current industrial soil RSLs and Eco-SSLs; however, detected in groundwater above screening criteria	Metals retained as COPCs for soil
Groundwater	VOCs – low level of toluene in one groundwater sample, but below current MCL and tap water RSL	VOCs not retained as COPCs for groundwater, but may be reconsidered for the RI analytical suite, if drums are located during the geophysical surveys
	SVOCs – none detected in groundwater, but low levels of PAHs detected in soil	SVOCs (limited to PAHs) retained as COPCs for groundwater
	Pesticides – DDE (above tap water RSL)	Pesticides retained as COPCs for groundwater
	PCBs – not detected in previous groundwater samples; no records suggesting the disposal of old transformers at AOC 1	PCBs not retained as COPCs for groundwater

Media	Potential Site Contaminants	Status
Groundwater (continued)	Explosives – not analyzed during the previous investigation at AOC 1; however, due to proximity to the former ammunition bunkers, containers contaminated with explosives compounds may have been disposed at AOC 1	Explosives retained as COPCs for groundwater
	Metals – Aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, manganese, and mercury (above MCLs and/or tap water RSLs)	Metals retained as COPCs for groundwater

5.2.2 Mechanisms of Release and Principal Routes of Migration

Potential release mechanisms for the AOC 1 COPCs include:

- Primary:
  - Adsorption to soil and sediment resulting from the subsurface disposal of waste materials and potential surface spills within the Abandoned Dumping Station
- Secondary:
  - Volatilization and wind erosion of particulates into ambient air
  - Infiltration and subsurface soil and groundwater from the Abandoned Dumping Station and surface releases
  - Overland runoff and erosion
- Tertiary:
  - Groundwater flow and discharge to surface water

Potential surface spills and direct disposal of waste at the Abandoned Dumping Station (AOC 1) may have led to the adsorption of contaminants to soil and sediment. Historically, surface runoff could have transported COPCs in soil, either as suspended solids or dissolved in water, to other areas on-site or off-site. Wind erosion could also have transported contaminants from soil into air. However, due to the porous nature of the sand substrate throughout AOC 1; the lack of adsorption material; the constant flushing of the area by tidal and storm activity; and the dynamic movement of sand in and out of the Cape May Inlet; it is likely that most of the contaminant material dumped at AOC 1 over 40 years ago has been redistributed through erosion and infiltration/leaching to subsurface soil and groundwater, and that little if any remains on or near the surface at AOC 1 with the possible exception of larger solids (e.g., metal objects and construction debris). COPCs which have migrated to the subsurface may now be bound in the semipermeable organic peat and silt within the buried marsh deposits ("Meadow Mat"), anticipated at a depth of approximately 6 ft below the ground surface along the shoreline.

5.2.3 Media of Concern

Unknown waste materials were potentially spilled and/or buried at the Abandoned Dumping Station (AOC 1). The previous investigation at AOC 1 focused on soil and groundwater; no sediment samples were collected. Based on the identified COPCs, mechanisms of release, and principal routes of migration, the media of concern at AOC 1 include surface soil, subsurface soil, sediment, and groundwater. Surface water will not be evaluated due to proximity to the ocean and tidal intrusion.

5.2.4 Contaminant Persistence

A discussion of contaminant persistence for the COPCs retained in **Section 5.2.1** is provided below.

<u>SVOCs</u>

Low levels of PAHs were detected in soil at AOC 1, but were not detected in groundwater. PAHs tend to sorb to soil, sediment, and other organic materials. PAHs are released to the environment naturally (e.g., forest fires) and anthropogenically (e.g., fuel combustion and waste incineration) (Canadian Council of Ministers of the Environment, 1999). High molecular weight compounds are less water soluble than lower molecular weight PAHs, and more likely to adsorb to suspended particles.

<u>Pesticides</u>

Pesticide compounds (including DDT and DDE) were detected at slightly elevated concentrations in soil and groundwater at the Abandoned Dumping Station (AOC 1). In general, pesticide compounds are immobile, resistant to biodegradation, and likely to become bound to soil and sediment particles in the water column [Hazardous Substances Data Bank (HSDB), 2010a; 2010b; and 2010c]. Pesticides also tend to bioaccumulate in plant and animal tissue. DDT use was banned in the United States in 1972; however, DDT and its breakdown products DDD and DDE have high adsorption and very low solubility and biodegradability, making them very persistent in the environment. In a 1993 NJDEP report entitled “A Summary of Selected Soil Constituents and Contaminants at Background Locations in New Jersey”, DDT was detected in background samples of surface soil (collected up to 12 inches below ground surface) ranging from 0.005 to 4.61 mg/kg, with an arithmetic mean of 0.0789 mg/kg. The corresponding DDE concentrations ranged from 0.002 to 1.77 mg/kg, with an arithmetic mean of 0.0658 mg/kg (NJDEP, 1993).

<u>Explosives Compounds</u>

As mentioned previously, explosives were not previously evaluated at AOC 1, but were retained as COPCs due to the proximity of AOC 1 to the former Ammunition Bunkers and potential for disposal of explosives-contaminated containers.

When released to water, explosives compounds (such as TNT and PETN) absorb to suspended solids and sediment. PETN, RDX, and TNT are unlikely to volatilize from soil. Hydrolysis (in fresh water) is not an important fate process for these compounds; however, RDX has been shown to hydrolyze in sea water. RDX also degrades in direct sunlight (HSDB, 2012). PETN may biodegrade in the environment (HSDB, 2010d). TNT is known to be readily reduced under anaerobic conditions (HSDB, 2007).

<u>Metals</u>

A variety of metals have been detected above comparison criteria in the soil and groundwater at AOC 1. Metals such as aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, and mercury occur naturally in the earth's crust and may be attributed to the mineralogy of the underlying geologic units. The presence of metals such as iron may also be the result of the corrosion of metallic debris in the Abandoned Dumping Station.

Aluminum is the most abundant metallic element, making up approximately 8 percent of the earth's crust. As such, aluminum compounds are typically found as a result of the weathering of rocks and minerals (HSDB, 2005). The median background aluminum concentration in the urban coastal plain environment is 6,200 mg/kg (Sanders, 2003). The maximum concentration of aluminum detected in soil during the Ogden (1998) study was 5.140 mg/kg from boring location DS-B4, which was well below screening criteria. Arsenic occurs most often as a compound with sulfide and other minerals (HSDB, 2009]. Chromium is most stable in the trivalent state (HSDB, 2016a). Cobalt is often found in association with nickel or arsenic (HSDB, 2017). Cobalt is unlikely to bioaccumulate in the food chain. Lead is typically transformed to organic complexes in the environment (HSDB, 2016b). Mercury and lead become strongly sorbed to organic materials and accumulate in sediments and plant and animal tissue.

When released to the environment, metals tend to sorb to soil, sediment, and other organic materials. They also cannot be degraded or detoxified [Federal Remediation Technologies Roundtable (FRTR), 2007], but can change valence state and become more stable.

5.2.5 Contaminant Migration

Contaminant migration can occur through advection, dispersion, diffusion, volatilization, and sorption. Due to the chemical properties of the AOC 1 contaminants and time elapsed since potential releases of contamination, dispersion, diffusion, and volatilization would not be considered significant contributors to contaminant migration.

<u>SVOCs</u>

The types of SVOCs (primarily PAHs) observed in the soil at AOC 1 could be bound to more highly organic soil and sediment particles, but in the sandy conditions at the site are more likely to migrate via advective transport (bulk movement) with the flow of surface water or groundwater.

<u>Pesticides</u>
In general, pesticide compounds are immobile, resistant to biodegradation, and likely to become bound to soil and sediment particles in the water column (HSDB, 2010a, 2010b, and 2010c).

<u>Explosives Compounds</u>
PETN and TNT have low mobility in soil (HSDB, 2007 and 2010d); whereas, RDX has high to moderate mobility (HSDB, 2012). Explosives compounds are more likely to migrate via advective transport in surface water and groundwater.

<u>Metals</u>
Most of the metals observed in the sandy soil at AOC 1 would migrate via advective transport (bulk movement). Desorption is dependent on the solubility of the individual chemical and pH of the soil. For example, arsenic is more mobile in soil at high pH (HSDB, 2009). Soluble inorganic arsenate is more thermodynamically stable in water than arsenite (HSDB, 2009). Aluminum is highly soluble at low pH (HSDB, 2004). The most common valence states of chromium are III and VI (hexavalent chromium or chromate). Hexavalent chromium rarely occurs in nature, trivalent chromium is more stable and is the predominant state found in soils. Trivalent chromium has low solubility and low mobility in soil (HSDB, 2016a). At pHs below 5, trivalent chromium forms a stable complex with water; whereas, at pHs above 9 negatively charged hydroxides are formed. In contrast, hexavalent chromium is relatively soluble and mobile (HSDB, 2016a). At pHs below 6 to 7, cadmium desorbs from soil (FRTR, 2007). Lead compounds have limited mobility when released or deposited on soil (HSDB, 2016b). In contrast, mercury is very mobile in the environment. Volatile forms of mercury evaporate to the atmosphere, while solid forms of mercury partition to particulates (FRTR, 2007).

5.3 Development of the Preliminary CSM

A preliminary CSM was developed for the Site, based on Bluestone’s review of historical records and published reference documents, including: i) nature and extent of contamination from previous investigations (**Section 2.0)**; ii) physical characteristics of the Site (**Section 4.0)**; iii) contaminant fate and transport (**Section 5.2**); iv) land use and ecological setting (**Section 5.3.1)**; and, v) exposure pathway analysis (**Section 5.3.2**). The CSM for human receptors is provided as **Figure 5-1**. The CSM for ecological receptors is provided as **Figure 5-2**. Details of the potential human and ecological receptors and pathways are provided in **Section 9.0**.

5.3.1 Current and Future Land Use and Ecological Setting

The current and future land uses and ecological settings for the Abandoned Dumping Station (AOC 1) are provided below. These assumptions are carried throughout the Expanded Technical Memorandum.

The Abandoned Dumping Station (AOC 1) is located on the USCG Training Center Cape May along the inlet shoreline; there is no public access. Occasional bird-watching groups visit the area (adult recreational visitors – guided access only). Although there are no known disposal records, it is believed that the Abandoned Dumping Station (AOC 1) was used primarily for the dumping of municipal waste.

Substantial shoreline erosion has reduced the land-area of AOC 1. The remaining area is undeveloped shoreline. No buildings are located on-site and the construction of buildings on-site is not feasible because of the location along the shoreline within the intertidal zone and within the area commonly inundated during king tides and storm surges. Land use is expected to remain unchanged in the future.

Groundwater at the Site is not currently used as drinking water and is not expected to be used as a drinking water source because of saltwater intrusion. The Abandoned Dumping Station (AOC 1) is inundated with ocean water ten times per year and much of the area is saturated two times a day, at high tide. During the previous investigation, groundwater was encountered at less than 4 ft bgs at the Abandoned Dumping Station (Ogden, 1998).

Terrestrial habitats at AOC 1 are of poor quality, are relatively small (less than 0.5 acres), and are dominated by invasive species typical of ruderal habitat. A more detailed presentation of the ecological setting at AOC 1 is provided in **Section 9.0**.

5.3.2 Potential Human and Ecological Pathways

In general, an exposure pathway consists of the following components:

- Source and mechanism of chemical release to the environment;
- Environmental transport medium;
- Point of contact with the contaminated medium (exposure point); and,
- Exposure route at the exposure point.

If all four components are present (or potentially present), the pathway is considered complete (or potentially complete). Each pathway defines a unique mechanism by which potential human and ecological receptors are directly or indirectly exposed to contamination.

Potential source areas are discussed in **Section 5.1**. Release mechanisms and contaminant migration (transport) associated with AOC 1 are summarized in **Section 5.2.2**. Media of concern for human receptors include surface soil, subsurface soil, sediment, and groundwater. Media of concern for ecological receptors include surface soil and sediment.

<u>Potential Human Health Receptors and Exposure Routes</u>

Section 9.0 provides details of the human health exposure pathway analysis. Below is a brief summary of the identified potential receptors and exposure routes.

Identified potential receptors include:

- Current recreational visitors (adult recreational visitors – guided access only),
- Current adolescent trespassers, and
- Potential future construction workers.

Recreational visitors may be exposed to contaminants in surface soil through ingestion and dermal contact. Adolescent trespassers may be exposed to contaminants in surface soil and sediment through ingestion and dermal contact. Construction workers may be exposed to contaminants in surface and subsurface soil (0 to 10 ft bgs, or to the water table) through ingestion and dermal contact and shallow groundwater through dermal contact and through inhalation of volatiles in trench air. Particulates in ambient air (dust arising from surface soil or subsurface soil during excavation activities) could also be a potential exposure medium (through inhalation). These pathways are considered potentially complete.

<u>Potential Ecological Receptors and Exposure Routes</u>

As with the human health risk assessment, **Section 9.0** provides a more detailed discussion of ecological pathways to be considered when assessing ecological risk potential at AOC 1. There are two small areas within AOC 1 that are of potential concern for ecological receptors: the approximately 0.5-acre vegetated area in the eastern portion of AOC 1 and the narrow segment of beach (approximately 200 ft long) located west of the vegetated area (see **Figure 2-1**). The remaining portions of AOC 1, primarily underwater, are extremely dynamic and have been subject numerous storm and tidal events that resulted in a biotic zone whose current characteristics cannot be attributed to historical DoD activity in the area.

Consideration for exposure pathways of potential concern is provided in **Figure 5-2** and recommendations for the need for further ecological risk evaluation are presented. A more detailed discussion of the receptor considered for the screening-level ecological risk assessment is provided in **Section 9.2**.

Due to the limited likelihood of exposure of ecological receptors at AOC 1 to contamination resulting from historical DoD dumping activities that occurred over 40 years ago, a complete ecological exposure pathway of concern is not present.

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6.0 DATA QUALITY OBJECTIVES

The Data Quality Objective (DQO) Process has been used to develop a sampling design for AOC 1. This process began with the evaluation of potential exposure pathways and exposure scenarios for development of the preliminary CSM in **Section 5.0**. The seven steps in the DQO Process (EPA, 1993) are presented below.

1. State the Problem
2. Identify the Decisions/Goals of the Study
3. Identify Inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule/Analytic Approach
6. Specify Limits on Decision Errors
7. Optimize the Design for Obtaining Data

<u>Step 1</u>: Contamination may have been released to surface soil, subsurface soil, sediment, and groundwater because of historical activities at AOC 1. Metals (including aluminum, arsenic, chromium, lead, and nickel) and pesticide compounds (including DDT and DDE) may pose a risk to human and ecological receptors.

<u>Steps 2 through 5</u>: Flowcharts outlining the general approaches for the Human Health Risk Assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA) are presented in **Section 9.0**. Throughout the risk assessment process, the team will look for potential data gaps that if filled, will help to reduce uncertainty.

The major components of the RI are provided below:

- <u>Conduct Multi-Media Sampling</u>. Collect data representative of human and ecological exposures and determine if contaminants are present above available human health and ecological screening criteria in surface soil, subsurface soil, sediment, and groundwater.
- <u>Perform a Screening Level HHRA</u>. If human health screening criteria are exceeded in any of the media of concern, proceed to Refined Screening Level HHRA.
- <u>Perform a Refined Screening Level HHRA</u>. If the Refined screening Level HHRA indicates risks exceeding target risk thresholds proceed to Baseline HHRA.
- <u>Perform a Baseline HHRA</u>. If necessary, proceed to the Baseline HHRA, determine if contamination poses risks exceeding target risk thresholds to construction workers, adolescent trespassers, and recreational visitors.
- <u>Perform a SLERA.</u> If complete ecological risk assessment pathways are identified during the problem formulation, initiate the SLERA process.

Steps 6 through 7: Uncertainty is evaluated throughout RI data collection and validation. Throughout the RI and risk assessment development, there are opportunities to address data gaps and to optimize the sampling plan.

7.0 DATA GAPS IDENTIFICATION

Five potential data gaps were identified for the Abandoned Dumping Station (AOC 1), based on the historical records review and site visit:

- Data Gap #1 – Characterization of Potential Buried Waste: During the site visit, Mr. Hajduk (TRACENCM) mentioned that drums may have been buried at the Abandoned Dumping Station (AOC 1). Aerial photographs indicate that wastes were historically dumped at the surface. However, there are no disposal records and no indication that previous geophysical investigations or test pit excavations have been conducted for verification.

- Data Gap #2 – Soil and Sediment Sampling: There were no contaminants detected above current EPA industrial RSLs in soil at the Abandoned Dumping Station (AOC 1); however, low levels of DDE and DDT exceed current Eco-SSLs in one soil sample (DS-B4-SS-01, at a depth of 0-2 ft bgs). DDT, DDE, and total metals (aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, and mercury) were detected above current MCLs and/or tap water RSLs in groundwater. The detections of the pesticides DDT and DDE were isolated and just above the Eco-SSLs, thus may not warrant further investigation. Sediment was not collected during the previous investigation.

- Data Gap #3 – Monitoring Wells: The Site Survey Summary Sheet dated 19 September 1994 (USACE, 1994b) included a figure with four monitoring wells labeled in and around the Abandoned Dumping Station (AOC 1) (provided in **Appendix G**).

  The Project Summary Sheet dated 8 May 1995 (USACE, 1995a) proposed installation of four monitoring wells and a soil gas survey at the Abandoned Dumping Station (AOC 1), as well as soil sampling at the two Former Firing Ranges (AOCs 2 and 3). However, it appears that permanent monitoring wells may never have been installed within AOC 1. Instead, Ogden conducted a Geoprobe® investigation and collected groundwater directly from the soil borings in October 1997.

  There were no monitoring wells observed at AOC 1 during the site visit in October 2018.

- Data Gap #4 – Insufficient Background Data: Previous investigations did not include background sampling for soil, sediment, or groundwater. AOC 1 is located in an undeveloped area of the Site; however, it will be a challenge to identify uncontaminated areas outside the influence of the Site.

- Data Gap #5 – Unexploded Ordnance (UXO): The INPR for Cape May indicated that there were eleven formerly used ammunition bunkers and two former firing ranges located along the shoreline of the Site. While outside the purview of this FUDS HTRW project, the historical observation of small caliber bullets along the southern shoreline and former storage of ammunition in the bunkers on the Site, suggests that there may be a potential for encountering UXO during intrusive activities at AOC 1.

Mr. Hajduk (TRACENCM) also provided a UXO awareness brief to the site team, prior to entering AOC 1 during the site visit; which suggests that UXO support may be required during intrusive activities in this area.

8.0 RECOMMENDATIONS TO ADDRESS DATA GAPS

The approaches for addressing the five data gaps discussed in **Section 7.0** are discussed in this section and summarized in **Table 8-1**. A phased-approach is recommended for the RI as discussed below.

8.1 Data Gap #1 – Characterization of Potential Buried Waste

Recommendation: *Conduct geophysics to define the onshore and off-shore areal limits of AOC 1 and conduct test pits to determine the nature and extent of the onshore subsurface waste.*

Geophysical Investigation

A geophysical survey is proposed for the initial phase of the investigation, to locate potential buried containerized waste and metallic debris (**Figure 8-1**). The area for the geophysical survey includes approximately 0.9 acres off-shore and 1.76 acres onshore. The land survey will begin with an Electromagnetic (EM) survey, using EM-61 and/or EM-31 systems. EM-61 equipment has higher target resolution and is less susceptible to interference from ground or overhead sources, but its sensing capability is limited to depths of approximately 12 ft bgs. EM-31 has lower target resolution but can detect larger anomalies to depths of approximately 20 ft bgs. Method selection will be made based on site conditions and potential sources of interference. Ground Penetrating Radar (GPR) will be used to further characterize identified anomalies. Both methods are susceptible to interference from metallic objects, including cars and utility or overhead lighting poles.

The land surveys will be conducted in accordance with EM 1110-1-1802 *Geophysical Exploration for Engineering and Environmental Investigations* (USACE, 1995b) and American Society for Testing and Materials (ASTM) Method D6429 *Standard Guide for Selecting Surface Geophysical Methods* (ASTM, 2011). Location control will be provided using differential Global Positioning System (GPS), to ensure GIS-compatible mapping. The data will be recorded in the instrument's memory and transferred onto a laptop computer in the field. The data will be contoured and overlain on site base maps.

An aerial magnetometry survey using an Unmanned Aircraft System (UAS, or "drone") is recommended for the off-shore portions of AOC 1. The U.S. Army Engineer Research and Development Center's (ERDC's) Environmental Lab is currently developing in-house UAS capabilities. Commercial services are also available. All drones greater than 0.5 pounds must be registered with the Federal Aviation Administration (FAA), and they cannot exceed 55 pounds. Permission will be required from TRACENCM prior to the performance of the aerial survey. As with the land surface geophysical survey, location control will be provided using differential GPS, to ensure GIS-compatible mapping, data will be recorded in the instrument memory and transferred to field laptop, and the data will be contoured and overlain on site maps.

The results of the geophysical investigation will be used to select locations for test pits and to confirm the proposed locations and depths for the soil borings and new monitoring wells within AOC 1.

Test Pits

A total of three test pits are proposed within the boundaries of the Abandoned Dumping Station (AOC 1) to determine the nature and extent of the buried debris. The locations of test pits will be field determined, based on the results of the geophysical investigation. Soil within the test pits will be described in accordance with ASTM D2487-17 (*Standard Practice for Classification of Soils for Engineering Purposes – Unified Soil Classification System)* (ASTM, 2017), and any debris observed within the test pits will be noted in the field log.

Up to five soil samples will be collected from each test pit (one from each of the four side walls in each pit and one from the floor of each pit) for chemical analysis. Due to the unknown nature of the waste within the Abandoned Dumping Station (AOC 1), soil samples will be analyzed for TCL SVOCs [EPA Method 8270, with selected ion monitoring (SIM) for low-level PAHs], pesticides (EPA Method 8080), explosives (EPA Methods 8330B), and TAL metals (EPA Method 6010/6020 and EPA Method 7471 for mercury).

8.2 Data Gap #2 – Soil and Sediment Sampling

Recommendation: Conduct additional soil sampling (surface and subsurface) to confirm whether contaminants found in groundwater contaminants remain in site soil. Include metals and pesticides as COPCs for soil, along with other potential site-related contaminants (such as SVOCs and explosives compounds). Collect subsurface soil samples from up to five soil borings at the Abandoned Dumping Station (AOC 1), at locations selected based on the results of the geophysical survey. Collect up to 15 surface soil and 15 sediment samples.

Subsurface Soil

During the second phase of the investigation, up to five soil borings will be collected using a Direct Push Technology (DPT) rig. During the Ogden investigation, groundwater was encountered at a depth of less than 4 ft bgs at AOC 1. As a result, two soil samples have been proposed for chemical analysis from each DPT boring during the RI: one shallow sample (from 1 to 2-ft bgs) and one deeper sample (from approximately 2 to 4-ft bgs). Subsurface soil samples will not be collected below the water table. The two samples collected per boring will aide in defining the extent of contamination both horizontally and vertically. By collecting a minimum of 10 subsurface soil samples (i.e., two from each of five borings), an adequate data set is available for the calculation of 95% Upper Confidence Limits (UCLs), using EPA's ProUCL statistical software.

The DPT rig will be used to hydraulically advance a small diameter (2 to 3-inch outside diameter) stainless steel core barrel lined with acetate sleeves for sample collection. The core barrel contains a retractable drive point that is pushed to sampling depth. Once the top of the sampling depth is reached, the drive point is retracted, the core sampler is driven further, and soil is collected within the acetate liners installed within the empty stainless steel core barrel. As the final sample depth is reached; the core barrel is extracted. This process will repeat as soil samples are collected from each boring location to provide a continuous profile.

Drilling logs will be completed in accordance with USACE Engineer Manual 1110-1-4000, *Monitoring Well Design, Installation, and Documentation at Hazardous Toxic and Radioactive Waste Sites* (USACE, 1998). Soils will be described in accordance with ASTM D2487-17 (*Standard Practice for Classification of Soils for Engineering Purposes – Unified Soil Classification System)* (ASTM, 2017). Each log will include general information regarding the drilling contractor, boring location, drilling method, borehole depth and diameter, weather conditions, depth to groundwater, ground surface elevation, description of samples collected (i.e., soil type, color, and moist/dry), organic vapor analyzer (OVA) readings, and field notes.

At locations where groundwater monitoring wells will not be installed, soil cuttings will be placed back into the borehole from which they were removed unless the soil is visibly contaminated. Any removed contaminated soil must be covered and protected from rainfall. Erosion control measures will be required around the removed contaminated material, until it can be containerized and removed from the Site. Bentonite will be used to finish backfilling the hole.

Subsurface soil samples will be analyzed for TCL SVOCs [EPA Method 8270, with SIM for low-level PAHs], pesticides (EPA Method 8080), explosives (EPA Method 8330B), and TAL metals (EPA Method 6010/6020 and EPA Method 7471 for mercury). Additional physical parameters [including grain size, total organic carbon (TOC), cation exchange capacity (CEC), oxidation reduction potential (ORP), pH, and moisture content] will be obtained as additional lines of evidence to support the discussions of fate and transport and risk assessment.

Surface Soil

During the second phase of the investigation, and as determined by the outcome of the geophysical investigation, discrete (grab) surface soil samples will be collected at up to 15 locations within the limits of the Abandoned Dumping Station (AOC 1). As discussed above for subsurface soil, a minimum of 10 surface soil samples will be required for statistical analysis using ProUCL. Additional samples have been proposed for areal coverage. Five of the 15 samples will be collocated with the subsurface soil borings, to provide a complete vertical contaminant profile.

Surface soil will be collected manually using a stainless-steel hand trowel or stainless-steel hand auger, at a depth of approximately 0 to 12 inches bgs. Surface soil samples will be analyzed for the same suite of analytical and physical parameters listed above for subsurface soil.

Sediment

During the second phase of the investigation and as determined by the outcome of the geophysical investigation, sediment samples will be collected at up to 15 locations within the limits of the Abandoned Dumping Station (AOC 1). Similar to surface soil, a minimum of 10 sediment samples will be required for statistical analysis using ProUCL; however, additional samples have been proposed for areal coverage.

Sediment samples will be obtained from a depth of 0 to 6 inches bgs (and not covered by more than 1-2 ft of surface water at mid-tide) using a Petit Ponar grab sampler, or equivalent. The sediment samples will be analyzed for the same suite of analytical and physical parameters listed above for surface soil.

8.3 Data Gap #3 – Monitoring Wells

Recommendation: Determine if any permanent monitoring wells have been installed previously at AOC 1. If there are no existing monitoring wells, or they are not in a condition suitable for chemical sampling, install up to five new site monitoring wells.

No monitoring wells were observed at AOC 1 during the site visit and it is not clear from the existing reports if permanent monitoring wells were installed. If any existing monitoring wells remain in the vicinity of the Abandoned Dumping Station (AOC 1), they should be inspected during the initial phase of the RI to determine if they can be used for a groundwater elevation survey. Since the wells would be at least 20 years old, it is unlikely that they would be suitable for groundwater sampling.

During the second phase of the investigation, up to five new groundwater monitoring wells will be installed at AOC 1, collocated with the soil borings at locations selected based on the results of the geophysical investigation.

The groundwater encountered at AOC 1 during previous investigations may be perched groundwater, due to the decreased hydraulic conductivity of the underlying Meadow Mat. Care should be taken in drilling through the Meadow Mat, as contamination present in the overlying sand may be dispersed to the Meadow Mat or to underlying units. Drilling logs and well completion diagrams will be completed in accordance USACE Engineer Manual 1110-1-4000, as discussed above for subsurface soil sampling. The well specifications will include the screen and casing diameter, total depth of the well, screened interval, sand pack interval and type of sand used, bentonite seal interval, grout interval, and well finishing specifications (protective casing, concrete pad, and bumper guards). In addition, the method of well development and all recorded parameters (volume of groundwater removed from the well, and standards measurements such as depth to water, turbidity, pH, temperature, etc.) will be noted.

Groundwater samples will be collected from the newly installed monitoring wells. Due to the unknown nature of the potential buried waste materials, the groundwater samples will be analyzed for TCL SVOCs [EPA Method 8270, with SIM for low-level PAHs], pesticides (EPA Method 8080), explosives (EPA Method 8330B), and TAL metals (EPA Method 6010/6020 and EPA Method 7470 for mercury). Depending on the results of the first round of groundwater sampling, a second round may be proposed to evaluate seasonal impacts on groundwater quality.

8.4 Data Gap #4 – Background Sampling

Recommendation: Perform a background study for soil, sediment, and groundwater.

The RI Contractor will coordinate with TRACENCM to identify appropriate locations for background sampling in uncontaminated areas outside the influence of AOC 1, with similar physical conditions (soil type, soil color, vegetative cover, forest canopy, drainage, elevation, etc.). The Site is heavily developed and was historically utilized as an airfield, so it will be a challenge to find appropriate background locations on the USCG property. Separate rights of entry will be needed if sampling off-site.

Background surface soil and sediment samples will be collected and analyzed in the same manner as the AOC 1 samples, from up to five background locations per media. However, based on discussions with the USACE Project Delivery Team (PDT) on 13 November 2018, it may not be feasible to locate unimpacted areas suitable for sediment sampling in this region.

Background samples for subsurface soil will be obtained from the borings selected for the installation of two upgradient background monitoring wells. Background subsurface soil samples will be analyzed for the same suite of parameters as the AOC 1 samples.

If appropriate locations cannot be located for background soil sampling, regional or U.S. background may be obtained from the following sources:

- *Environmental Assessment and Risk Analysis Element, Research Project Summary: Ambient Levels of Metals in New Jersey Soils* (NJDEP, 2003)
- *Geochemical and Mineralogical Data for Soil of the Conterminous United States* (USGS, 2013)

Regional or U.S. background may not be available for sediment or groundwater.

8.5 Data Gap #5 – Unexploded Ordnance

Recommendation: Contact TRACENCM to determine if UXO support is required during intrusive activities at AOC 1 (i.e., soil boring, well installation, and soil/sediment sampling).

According to Mr. Hajduk, no UXO has been found during construction activities at TRACENCM; however, two inert rounds were found once on the beach after a severe erosional event. UXO support was not used during the installation of the sheet piling adjacent to the perimeter road near the Abandoned Dumping Station (AOC 1), or during the removal action at the Former Firing Range (Hajduk, 2018).

9.0 RISK ASSESSMENT APPROACH

This section describes the general approaches that are recommended to estimate the potential risks to human and ecological receptors potentially exposed to contamination present in site groundwater, soil, and sediment. The approaches are based on the current and reasonably anticipated future uses of AOC 1 and site-specific preliminary problem formulation and exposure pathway analyses.

9.1 Human Health Risk Assessment

The HHRA is an iterative process involving four steps:

- Preliminary Problem Formulation and Exposure Pathway Analysis,
- Screening Level HHRA,
- Refined Screening Level HHRA, and
- Baseline HHRA.

Following the review of the approach to the HHRA in **Section 9.1.1, Section 9.1.2** provides a site-specific preliminary problem formulation and exposure pathway analysis.

9.1.1 General Approach to the HHRA

A flowchart outlining the general approach for the HHRA is presented as **Figure 9-1**. The flowchart not only identifies when additional assessment is required, but also highlights decision points when one can exit the process leading to a finding of No Further Action Required. Associated notes explain each consideration and decision point and explain site-specific considerations.

<u>Preliminary Problem Formulation and Exposure Pathway Analysis</u>

The initial step in the process is the preliminary problem formulation and exposure pathway analysis. This step is completed through development of the preliminary CSM (**Section 5.3, Figure 5-1**). If there are no potentially complete pathways, no further risk assessment is needed. If potential pathways exist, available data are reviewed to determine whether data are sufficient to proceed with an HHRA.

For AOC 1, available data have been determined to be insufficient and further RI sampling is recommended. Following RI sample collection, analysis, and data validation, the new data will be reviewed for completeness, representativeness, and adequate data quality for risk assessment purposes. If data are sufficient, the process will proceed toward the screening level risk assessment. Data will be compiled and compared to background concentrations. If DoD-related contamination is present at concentrations exceeding background levels, a Screening Level HHRA will be performed. A preliminary human health risk assessment problem formulation and exposure pathway analysis is presented following this discussion of the steps of the HHRA process.

Screening Level HHRA

In the Screening Level HHRA (the data evaluation and hazard identification portion of the HHRA), data are compiled and compared to risk-based screening levels. If all concentrations fall below these conservative screening levels, no further human health risk assessment is necessary. The Screening Level HHRA also evaluates the data for the presence of areas of high concentration that could be addressed through an interim removal action. If areas of high concentration are apparent that are likely to drive risk, an interim removal action will be considered prior to completion of the risk assessments. Receptors, exposure pathways, and land uses that were not evaluated in the Screening Level HHRA or which had COPCs exceeding screening levels or COPCs without screening levels will be carried forward into the Refined Screening Level HHRA.

Refined Screening Level HHRA

The Refined Screening Level HHRA will use exposure point concentrations and conservative scenarios (a recreational visitor, trespasser. and a construction worker) and a risk ratio approach to calculating individual COPC hazard quotients (HQs) and cancer risks, as well as cumulative hazard indices (HIs) and cancer risks. Cancer Risks from multiple COPCs are considered additive. Non-cancer health hazards from multiple COPCs exceeding target threshold of 1 should be refined to present target organ and target system specific HIs. If no risks in excess of target risk thresholds are identified, a Baseline HHRA is not needed. If there are risks in excess of target risk thresholds, site-specific lines of evidence and site-specific refinements of exposure factors will be reviewed and applied as appropriate. An uncertainty analysis will be performed. With consideration of uncertainties, if risks in excess of target risk thresholds remain, the PDT will determine whether those scenarios with risks in excess of target risk thresholds need to be included in a Baseline HHRA.

Baseline HHRA

The Baseline HHRA consists of Data Evaluation/Hazard Identification, Exposure Assessment, Toxicity Assessment, Risk Characterization, and an Uncertainty Analysis. If initial estimated risks exceed target risk thresholds, risk assumptions will be revised using available site-specific information and risks will be re-calculated. Once a Baseline HHRA has been completed, review of the results with consideration of the inherent uncertainties is critical to risk management decisions regarding the need for remediation and progress to a Feasibility Study.

9.1.2 Site-Specific Preliminary Human Health Problem Formulation and Exposure Pathway Analysis

In general, an exposure pathway consists of the following components:

- Source and mechanism of chemical release to the environment;
- Environmental transport medium;

- Point of contact with the contaminated medium (exposure point); and,
- Exposure route at the exposure point.

If all four components are present (or potentially present), the pathway is considered complete (or potentially complete). Each pathway defines a unique mechanism by which potential human and ecological receptors are directly or indirectly exposed to contamination.

Potential source areas are discussed in **Section 5.1**. Release mechanisms and contaminant migration (transport) are summarized in **Section 5.2.2**. Media of concern for human receptors include surface soil, subsurface soil, sediment, and groundwater. This section discusses the potential human exposure routes.

Problem formulation/exposure pathway analysis includes:

- A review of land use (both current and anticipated future uses);
- Review of site history and historical data;
- Development of a preliminary CSM, which includes describing the source of contamination, the transport and release mechanisms, the exposure media, the exposure routes, and the potentially exposed populations; and,
- Identification of potential exposure media, COPCs, and receptors. Consider land-use restrictions in determining potential future receptors. If no land-use restrictions are in place, even if current land-use is non-residential, consider hypothetical future residents. If land-use restrictions are in place for a particular scenario, no further assessment of that scenario is needed. Eliminate any receptor/medium not present or potentially present under reasonably foreseeable future land use.

Land Use

The Abandoned Dumping Station (AOC 1) is located on the USCG Training Center Cape May along the inlet shoreline; there is no public access. Occasional bird-watching groups visit the AOC (adult recreational visitors – guided access only). Substantial shoreline erosion has reduced the land-area of the AOC. The remaining area is undeveloped shoreline. Land use is expected to remain unchanged in the future.

Site History

Site history and historical data indicate a potential release of DoD related contaminants in groundwater at AOC 1. AOC 1 is an abandoned dumping station; however, details regarding disposal history have not been found in the historical records. Although there are no disposal records, it is believed that the AOC was used for the dumping of municipal waste. A geophysical survey is recommended to rule out the presence of drums or UXO and determine extent of debris underwater. **Section 2.1** of this Technical Memorandum describes findings of historical investigations and identified COPCs. Concentrations of pesticides and metals greater than screening levels have been found in groundwater at AOC 1. Concentrations of DoD-related contaminants greater than screening levels and background have not been found in soil at AOC 1 to date. Preliminary COPCs include pesticides and metals in groundwater. Further sampling of surface soil, shallow groundwater, subsurface soil above the water table, and sediment 0-6 inches in depth and not covered by more than 1-2 ft of surface water at mid-tide is recommended with analysis of SVOCs [including polycyclic aromatic hydrocarbons (PAHs)], pesticides, metals, and explosives. COPCs will be further refined as the project progresses.

Preliminary CSM

A preliminary CSM is provided as **Figure 5-1**. Sources and transport mechanisms are described in **Section 5.0**. Potential exposure media include soil, sediment, surface water, groundwater, and air. **Figure 5-1** illustrates the recommended potential human health receptors and exposure routes based on available information.

Potential Human Health Receptors and Exposure Routes

The following preliminary identification of human exposure pathways is based on historical data. A re-assessment of potential human exposure pathways will be needed after completion of the RI data collection and analysis.

Identified potential receptors include:

- Current recreational visitors (adult recreational visitors – guided access only);
- Current adolescent trespassers; and,
- Potential future construction workers.

No land-uses restrictions are in place; however, AOC 1, owned by USCG, is an Abandoned Dumping Station located on the USCG Training Center Cape May along the shoreline. There is no public access and no anticipated changes to land use. No buildings are located at AOC 1 and construction of buildings at AOC 1 is not feasible because of the location along the shoreline within the intertidal zone and within the area commonly inundated during king tides and storm surges. Therefore, there is no potential for either current or future residential or industrial land-use. Substantial shoreline erosion has reduced the land-area of the AOC.

Likely human receptors exposed to soil and sediment at AOC 1 would include recreational visitors and adolescent trespassers. Occasional bird-watching groups visit AOC 1 and surrounding areas (adults – guided access only). In addition, construction workers may contact surface and subsurface soil during excavation work. Recreational visitors may be exposed to contaminants in surface soil through ingestion and dermal contact. These pathways are considered potentially complete. Adolescent trespassers may be exposed to contaminants in surface soil and sediment through ingestion and dermal contact. These soil and sediment pathways are considered potentially complete. Although trespasser contact with surface water is also likely, because of the twice daily tidal movement of surface water, contact with site-related contamination through surface water is unlikely. Therefore, exposures to contamination in surface water is not considered a complete pathway. Evaluation of surface water exposure is not recommended.

Particulates in ambient air (dust arising from surface soil or subsurface soil during excavation activities) could also be a potential exposure medium (through inhalation). As a conservative approach, this pathway is considered potentially complete for all receptors exposed to soil.

Groundwater at AOC 1 is not currently used as drinking water and is not expected to be used as a drinking water source because of saltwater intrusion. The entire Abandoned Dumping Station (AOC 1) is inundated with ocean water ten times per year and much of the area is saturated two times a day, at high tide. Therefore, this pathway is considered incomplete.

Groundwater at AOC 1 is shallow. During the previous investigation, groundwater was encountered at less than 4 ft bgs at the Abandoned Dumping Station (Ogden, 1998). Therefore, potential dermal contact with shallow groundwater and inhalation of vapors in trench air during future excavation projects (such as roadwork) would be possible. These pathways are considered potentially complete; however, since no DoD-related VOCs have been detected in groundwater to date; the potential groundwater inhalation pathway is considered incomplete at this time. Potential ingestion of groundwater by construction workers is considered a minor pathway. Evaluation of this pathway is not recommended. The preliminary CSM (**Figure 5-1**) presents the recommended receptors, exposure routes and these complete exposure pathways.

9.2 Ecological Risk Assessment

The ERA, like the HHRA is an iterative process involving up to four general steps:

- Preliminary Problem Formulation
- Initial SLERA
- Refined SLERA (if needed)
- Baseline Ecological Risk Assessment (if indicated in the Refined SLERA).

Figure 9-2 and accompanying notes present the screening-level ecological risk assessment problem formulation for the Site. The flowchart not only identifies when additional assessment is required, but also highlights decision points when one can exit the process leading to a finding of No Further Action Required. Associated notes describe each consideration and decision point and explain site-specific considerations. Each of the general steps is described below.

9.2.1 Preliminary Problem Formulation

The problem formulation represents the initial step in a SLERA where the risk assessment objectives are stated, the problem is defined in the form of a preliminary conceptual site model (CSM – see **Figure 5-2**), and the approach for analyzing and characterizing the ecological risk is determined. The problem formulation includes: (1) definition of the study area and the characterization of the exposure setting for identification of potentially exposed habitats and associated flora and fauna; (2) development of information related to contaminant migration, sequestration, and exposure potential including uptake and trophic transfer of bioaccumulative chemicals (i.e., CSM); (3) selection of assessment endpoints relevant to community structure and function; and, (4) identification of measurement endpoints. The CSM presented in **Figure 5-2** provides a detailed evaluation of exposure pathways and receptor groups that are considered for the ecological risk assessment.

Ecological Setting

The Abandoned Dumping Station (AOC 1) is approximately 2 acres in size and is located on the eastern shoreline of NAS Cape May adjacent to the Cape May Inlet (see **Figure 2-1**). The terrestrial portion of AOC 1 is comprised of two distinct habitats: a roughly 200 ft sandy inter-tidal zone and a 0.4-acre vegetated area located in the southern portion of the site. The sandy inter-tidal zone varies in width from 15 -30 ft and is bordered on the land side by a narrow strip of American beach grass (*Ammophila breviligulata*) and an access road. The inter-tidal zone is highly dynamic ecosystem that is underwater during high tides and storm events, and frequently experiences significant erosion and scouring. The vegetated area in the southern portion of the site is ruderal in nature and is dominated by phragmites (*Phragmites australis*), Johnson grass (*Sorghum halepense*), sheep sorrel (*Rumex acetosella*), curly dock (*Rumex crispus*), seaside goldenrod (*Solidago sempervirens*), American beach grass, seaside spurge (*Euphorbia polygonifolia*), ragweed (*Ambrosia spp.*), and bull thistle (*Cirsium vulgare*). This portion of the site is also somewhat dynamic in that it is flooded daily during high tides, but does not experience erosion and scouring on a daily basis. The substrate for both habitats is composed predominantly of sand.

Due to their size and limited vegetation cover, the habitats present do not support diverse semi-aquatic or terrestrial wildlife communities. The most frequently observed resident species are fiddler crabs (*Uca spp.*), sand crabs (*Pagurus arcuatus*), and ghost crabs (*Ocypode quadrata*); in addition, the sandy beach portion of the site historically has served as a horseshoe crab (*Limulus polyphemus*) spawning area. Therefore, the site also may serve as a limited feeding area for shorebirds during their spring migration.

Contaminants of Potential Ecological Concern

There is limited information available regarding the extent and nature of dumping activities at this site. A study conducted in by Ogden (1998) sampled soil and groundwater for VOCs, SVOCs, pesticides, PCBs, and metals. No contaminant concentrations in soils exceeded soil criteria and no concentrations of VOCs, SVOCs, or PCBs were detected in groundwater. Only low-level detections of DDT and DDE in groundwater were reported above groundwater standards.

Contaminant Fate and Transport

Due to the porous nature of the sand substrate throughout the site; the lack of adsorption material; the constant flushing of the area by tidal and storm activity; and the dynamic movement of sand in and out of the Cape May Inlet (which was dramatically illustrated in the Data Collection Report (Ogden 1998)); it is likely that most of the contaminant material dumped at this site over 40 years ago has been redistributed through erosion and downward percolation and that little if any remains on or near the surface at the site with the possible exception of larger solids (e.g., metal objects and construction debris).

Potential Receptors and Complete Pathways

The following list provides a summary of each receptor groups for which an exposure pathway was considered complete and includes justification and recommendations regarding the disposition of these pathway/receptor combinations in the ecological risk assessment process:

- Inter-tidal invertebrate community: Sediment (sand) conditions are also highly dynamic and cannot be used assess historical DoD-related effects (not assessed further in ecological risk process);
- Soil invertebrate community: The surficial substrate for the site is primarily sand that is flooded daily with surface sand being removed and/or deposited frequently, in addition, the “soil” biotic zone is limited in size (aforementioned description) and any community level effects related to historical DoD activity is likely minimal and not of ecologically concern (not assessed further in ecological risk process);
- Terrestrial plant community: The vegetated portion of the site is roughly 0.4 acres and is comprised of mostly ruderal and invasive species and not of ecological concern (not assessed further in ecological risk process);
- Wading birds: Area use factors for wading birds are low (< 10%) and exposure to contamination present in the beach area where they might periodically forage would be limited (not assessed further in ecological risk process);
- Small mammals: The amount of suitable small mammal habitat present in AOC 1 is limited (approximately 0.4 acres) and frequently flooded, any small mammal exposure would be limited (not assessed further in ecological risk process); and,
- Terrestrial birds: Area use factors would be low and exposure would be limited (not assessed further in ecological risk process).

Habitat size and the dynamic nature of the sand substrate (especially the sandy shoreline) limits the resident biotic community present at AOC 1 to a few species and occasional use by migratory birds and spawning horseshoe crabs. Due to specific spawning requirements of the horseshoe crab (e.g., moderate beach sloping, sufficient oxygenation of the upper sand layer, continuous moisture levels sufficient to prevent egg desiccation), the only portion of AOC 1 suitable for horseshoe crab mating and egg laying is the narrow sandy shoreline. Since horseshoe crabs lay their eggs at a depth of 2-8 inches below the beach surface, it is highly unlikely that any historical DoD-related contamination could adversely impact the relatively small number of horseshoe crabs using this portion of the beach for spawning. As presented in the prior bulleted section, risk to receptors that feed on horseshoe crab eggs (i.e., wading birds) would have minimal exposure to any site-related contamination present.

Due to the limited likelihood of exposure of ecological receptors at the site to contamination resulting from historical DoD dumping activities that occurred over 40 years ago, complete exposure pathways of concern that warrant continued evaluation in the ecological risk assessment process are not present and No Further Ecological Risk Assessment activities are required.

9.2.2 Initial Screening Level Ecological Risk Assessment

Based on the results of the Problem Formulation, it was determined that no complete pathways of concern are present at AOC 1 and; therefore, a detailed Initial SLERA is not required.

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FIGURES

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Figure 1-1. Former Naval Air Station (NAS) - Cape May, New Jersey

Legend*

Former Shoreline

Potential Areas of Concern

N W E S

0 400 800 1,600 Feet

Scale is approximate - for illustrative purposes only.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator

Additional Sources: U.S. Army Corps of Engineers; Ogden, 1998; Dames & Moore, 1993.

*Feature locations are approximate.

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Figure 2-1. Former NAS Cape May - Abandoned Dumping Station

Legend
- Approximate Boring Location (Ogden, 1998)
- Former Shoreline
- Potential Area of Concern

N
W E
S

0 75 150 300 Feet

Scale is approximate - for illustrative purposes only.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator

Additional Sources: U.S. Army Corps of Engineers; Ogden, 1998.

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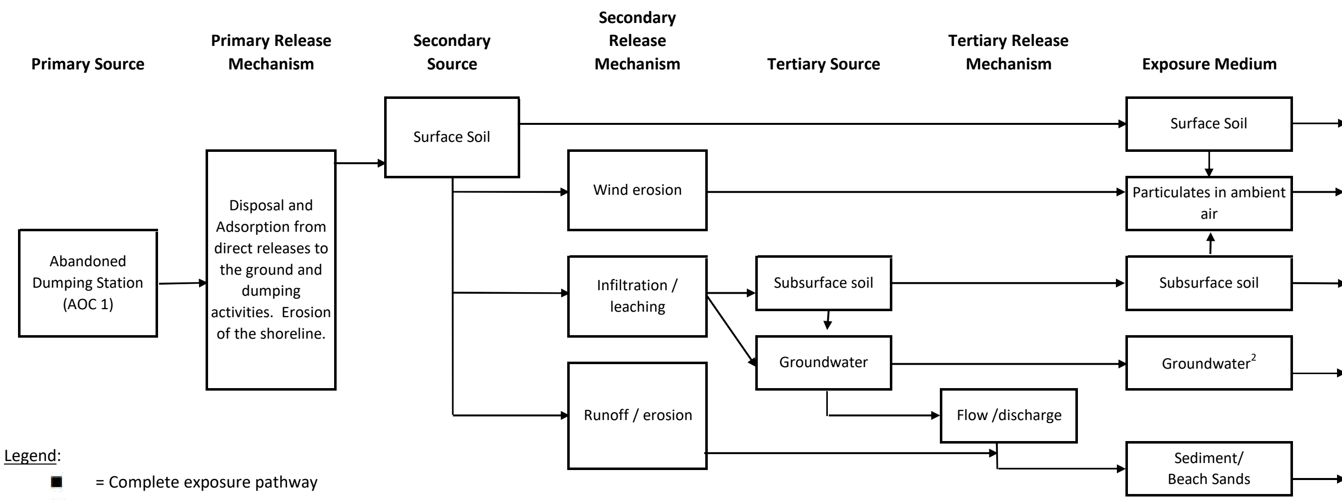
Figure 5-1. Former NAS Cape May
Preliminary Conceptual Site Model - Human Receptors



Exposure Medium	Exposure Route	Current/Future Construction Worker	Current/Future Adolescent Trespassers	Current/Future Adult Recreational Visitor
		Human Receptors[1] — **AOC 1 - Abandoned Dumping Station**		
Surface Soil	Incidental Ingestion	■	■	■
	Dermal contact	■	■	■
Particulates in ambient air	Inhalation	■	■	■
Subsurface soil	Incidental Ingestion	■	□	□
	Dermal contact	■	□	□
Groundwater[2]	Incidental Ingestion	□	□	□
	Dermal contact	■	□	□
	Inhalation	□	□	□
Sediment/ Beach Sands	Incidental Ingestion	□	■	□
	Dermal contact	□	■	□

Legend:

■ = Complete exposure pathway

□ = Incomplete exposure pathway

Notes:

1 No buildings are located on site and construction of buildings on site is not feasible because of the location along the shoreline within the intertidal zone and within the area commonly inundated during storms. Therefore, there is no potential for either current or future residential or industrial land-use. The Site is remote and has no public access. Therefore, potential receptors are limited to recreational visitors, adolescent trespassers, and construction workers who may make reparis to the existing roadway or may install erosion control measures.

2 Groundwater is not currently used as a drinking water source and is not expected to be used as drinking water in the future due to tidal intrusion and resulting salinity; therefore, groundwater is considered an incomplete exposure pathway for potable use of water. No buildings are located on site and construction of buildings on site is not feasible beause of the location along the shoreline within the intertidal zone and within the area commonly inundated during storms. Therefore, there is no potential for either current or future vapor intrusion. Groundwater is shallow; therefore, potential contact with shallow groundwater during excavation projects would be possible.

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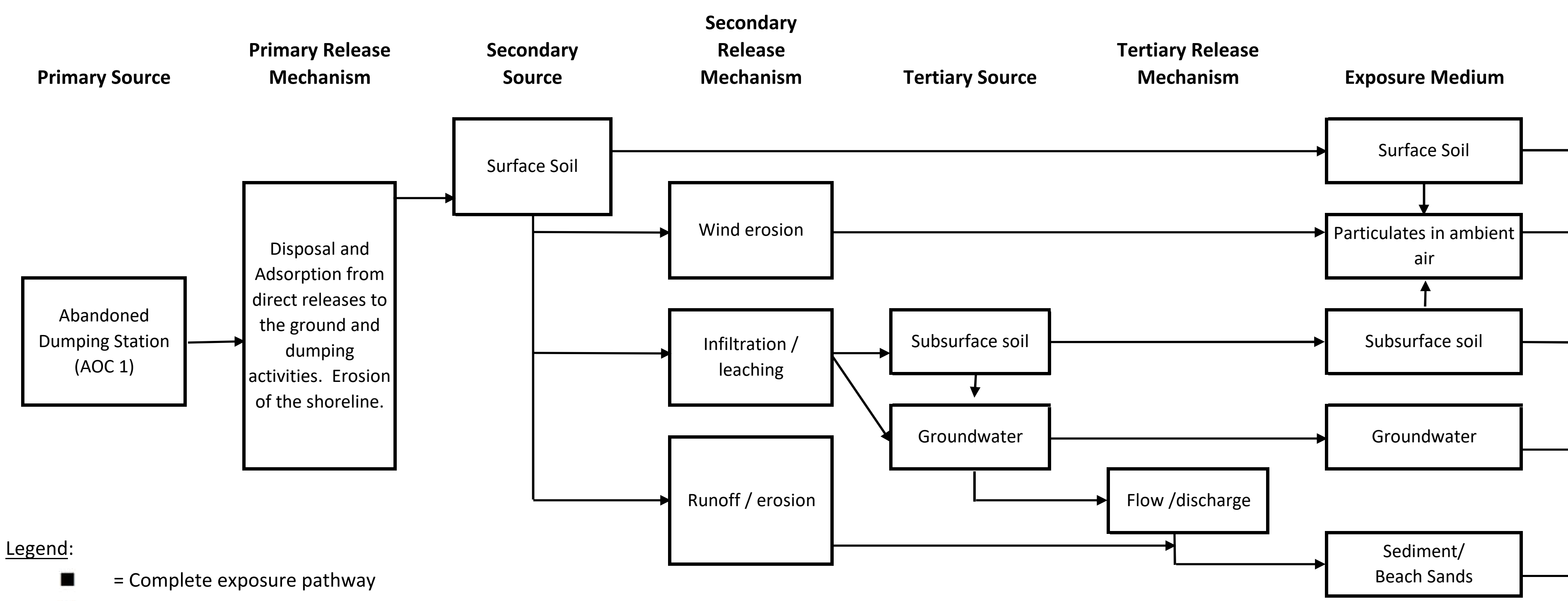
Figure 5-2. Former NAS Cape May
Preliminary Conceptual Site Model - Ecological Receptors



		AOC 1 - Abandoned Dumping Station					
		Terrestrial Receptors				Inter-tidal Zone Receptors	
Exposure Medium	Exposure Route	Plants	Invertebrates	Small Mammals (herviborous, invertivorous, carnivorous)	Birds (herviborous, invertivorous, carnivorous)	Invertebrates	Wading Birds
Surface Soil	Incidental Ingestion	☐	☒	☒	☒	☐	☐
	Dermal/direct contact	☒	☒	☒	☒	☐	☐
Particulates in ambient air	Inhalation	☐	☐	☐	☐	☐	☐
Subsurface soil	Incidental Ingestion	☐	☒	☐	☐	☐	☐
	Dermal/direct contact	☒	☒	☐	☐	☐	☐
Groundwater	Incidental Ingestion	☐	☐	☐	☐	☐	☐
	Dermal/direct contact	☐	☐	☐	☐	☐	☐
	Inhalation	☐	☐	☐	☐	☐	☐
Sediment/ Beach Sands	Incidental Ingestion	☐	☐	☐	☐	☒	☒
	Dermal/direct contact	☐	☐	☐	☐	☒	☒

<u>Legend</u>:

■ = Complete exposure pathway

☐ = Incomplete exposure pathway

☒ = Complete but insignificant exposure pathway (see Section 9 for details)

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Figure 8-1. Former NAS Cape May - Abandoned Dumping Station Geophysical Survey Locations

Legend
- Approximate Boring Location (Ogden, 1998)
- Former Shoreline
- Potential Area of Concern

Proposed Geophysical Survey
- Offshore (0.90 ac)
- Upland (1.76 ac)

N E S W

0 75 150 300 Feet

Scale is approximate - for illustrative purposes only.

Coordinate System: NAD 1983 StatePlane New Jersey FIPS 2900 Feet
Projection: Transverse Mercator

Additional Sources: U.S. Army Corps of Engineers; Ogden, 1998.

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Figure 9-1a. Former NAS Cape May – Human Health Risk Assessment Flow Chart:

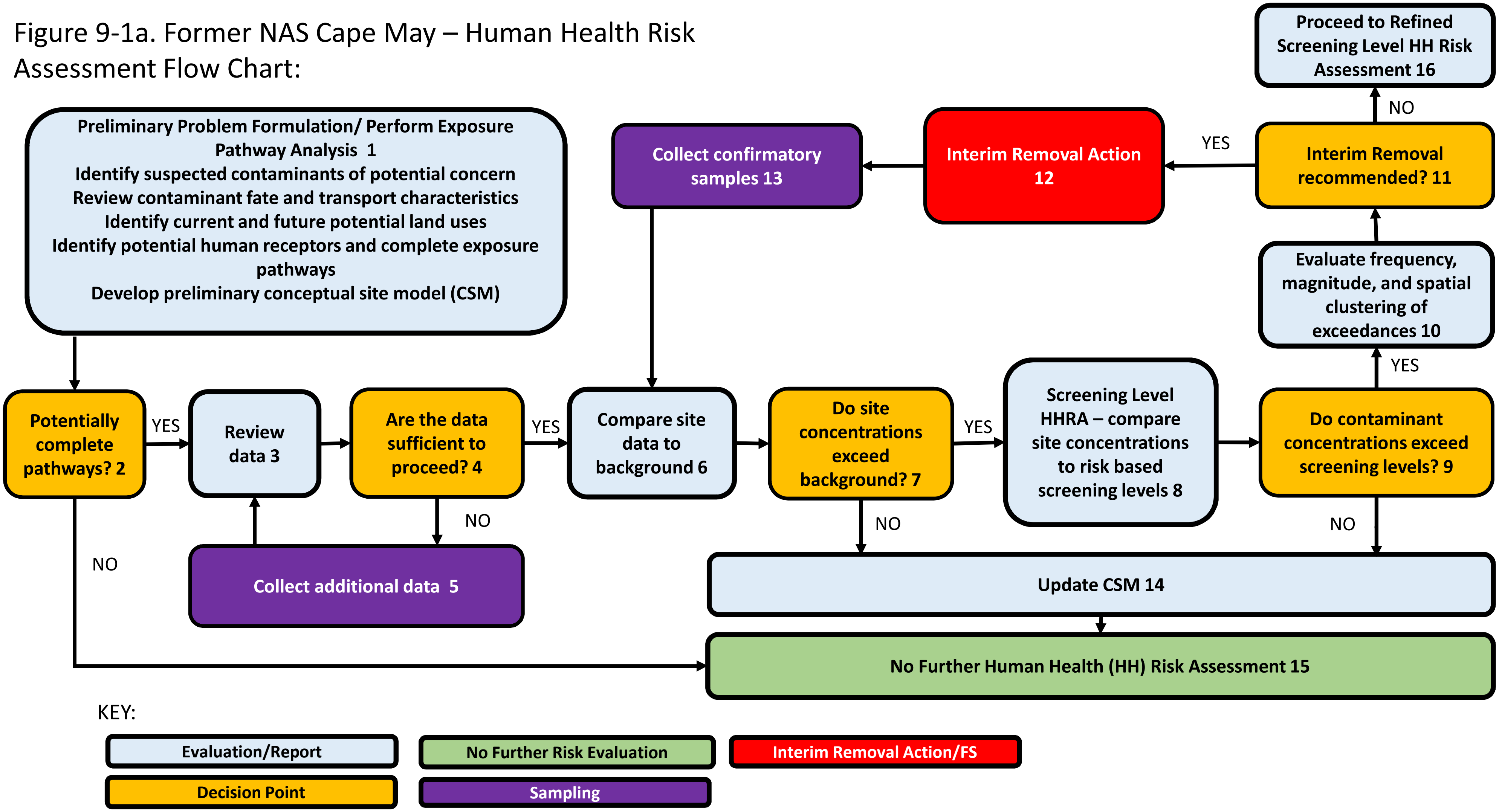


Figure 9-1b. Former NAS Cape May – Human Health Risk Assessment Flow Chart:

Refined Screening Level HHRA

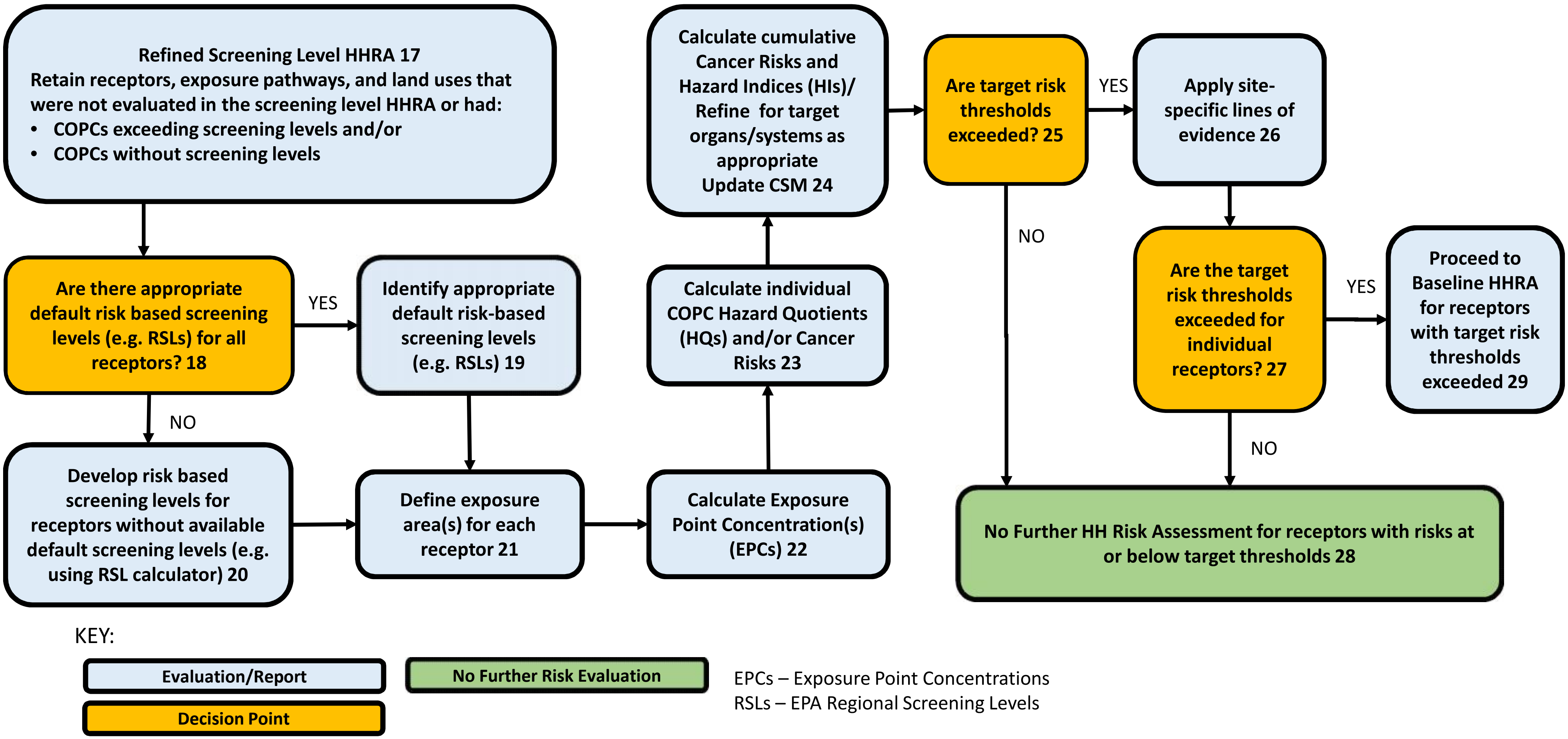
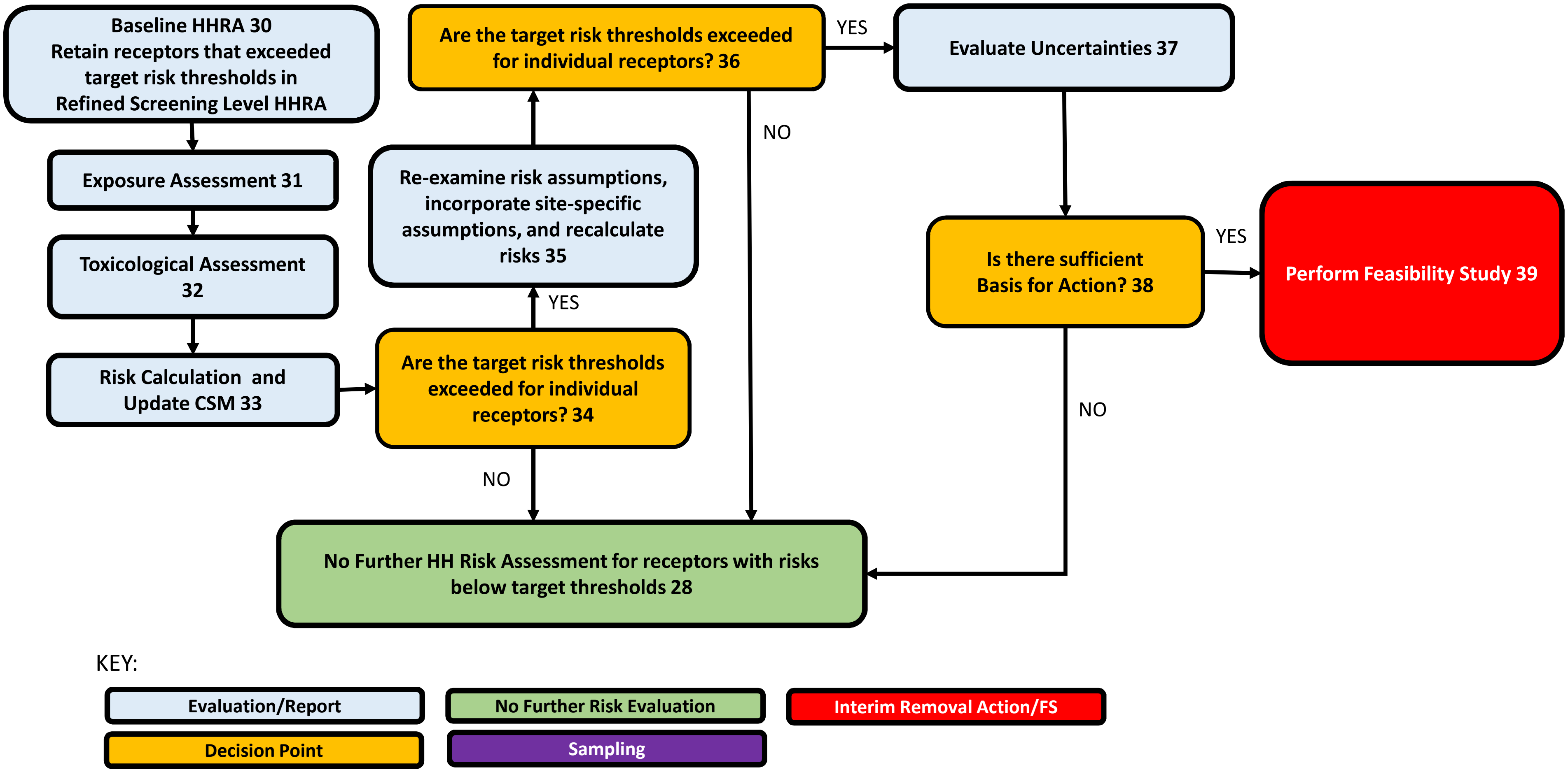


Figure 9-1c. Former NAS Cape May – Human Health Risk Assessment Flow Chart:

Baseline HHRA



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Formerly Used Defense Sites (FUDS)
Remedial Investigation (RI) Work Plan (WP)
Contract Number W912WJ-17-C-0014

Former NAS Cape May
Abandoned Dumping Station (AOC1)
Human Health Risk Assessment Flow Chart Text
(for Figure 9-1)

This flow chart assumes the site has been deemed FUDS eligible and contaminants of potential concern (COPCs) present are related to historical use of property by DoD. Red type explains considerations for Cape May to date.

1. Problem formulation/exposure pathway analysis includes:
   a) a review of land use (both current and anticipated future uses),
   b) review of site history and historical data,
   c) development of a preliminary conceptual site model (CSM), which includes describing the source of contamination, the transport and release mechanisms, the exposure media, the exposure routes, and the potentially exposed populations, and
   d) identification of potential exposure media, COPCs, and receptors. Consider land-use restrictions in determining potential future receptors. If no land-use restrictions are in place, even if current land-use is non-residential, consider hypothetical future residents. If land-use restrictions are in place for a particular scenario, no further assessment of that scenario is needed. Eliminate any receptor/medium not present or potentially present under reasonably foreseeable future land use.

   The Cape May site - the Abandoned Dumping Station (AOC 1) - is located on the USCG Training Center Cape May along the inlet shoreline; there is no public access. Occasional bird-watching groups visit the AOC (adult recreational visitors – guided access only). Substantial shoreline erosion has reduced the land-area of the AOC. The remaining area is undeveloped shoreline. Land use is expected to remain unchanged in the future.

   Site history and historical data indicate a release of DOD related contamination at the abandoned dumping station. Although there are no disposal records, it is believed that the AOC was used for the dumping of municipal waste. Pesticide and metal contaminants were found in groundwater. A geophysical survey is recommended to rule out the presence of drums or UXO and determine extent of debris underwater. Section 2.1 of the Technical Memorandum describes findings of historical investigations and identified COPCs.

   A preliminary CSM is provided in the Technical Memorandum (Figure 5-1). Sources and transport mechanisms are described in Section 5. Potential exposure media include soil, sediment, surface water, groundwater, and air. Identified potential receptors include current recreational visitors (adult recreational visitors – guided access only), adolescent trespassers, and potential future construction workers.

No land-uses restrictions are in place; however, the AOC, owned by US Coast Guard (USCG), is an Abandoned Dumping Station located on the USCG Training Center Cape May along the shoreline; there is no public access and no anticipated changes to land use. No buildings are located on the AOC and construction of buildings on the AOC is not feasible because of the location along the shoreline within the intertidal zone and within the area commonly inundated during king tides and storm surges. Therefore, there is no potential for either current or future residential or industrial land-use. Substantial shoreline erosion has reduced the land-area of the AOC.

Occasional bird-watching groups visit the AOC (adults – guided access only). There is the potential for adolescent trespassers.

Groundwater at the AOC is not currently used as drinking water and is not expected to be used as a drinking water source because of saltwater intrusion. The entire Abandoned Dumping Station is inundated with ocean water ten times per year and much of the area is saturated two times a day, at high tide.

Groundwater is shallow. Depth to groundwater at the AOC ranges from 3 to 8 feet bgs. There is the potential for construction workers to contact shallow groundwater during excavation work at AOC 1.

Preliminary COPCs include metals and pesticides in groundwater. Analyze soil, sediment, and groundwater for metals, SVOCs, pesticides, and explosives. COPCs will be further refined as the project progresses.

2. Are there potentially complete human exposure pathways? That is, is there contaminated media related to historical use of property by DoD that humans might contact either currently or in the future? Based on review of above are there people present (now or in the reasonable expected future) who may contact contaminated media? If not, there is no need for further human health risk assessment.

   At Cape May, there is the potential for complete exposure pathways for recreational visitors, adolescent trespassers, and future construction workers. Occasional guided adult bird-watching groups visit the Site. There is the potential for adolescent trespassers. There is the potential for construction workers to contact shallow groundwater during excavation work on site. Recreational visitors may be exposed to contaminants in surface soil and dust. Adolescent trespassers may be exposed to contaminants in surface soil, dust, and sediment. Construction workers may be exposed to contaminants in surface and subsurface soil (0 to 10 feet bgs or to the water table), dust, shallow groundwater, and volatiles in trench air.

3. Review data to check for data gaps, data quality, data representativeness of exposures.

   For Cape May, review of available historical data indicates the need for further groundwater, soil, and sediment sampling. Cape May is in the Work Plan development phase. The Technical Memorandum recommends sampling to addresses data gaps, that will be of sufficient quality for risk assessment, and that will be representative of the identified potential exposure area. Following collection of these data, further review will be needed to determine whether the collected data are sufficient to proceed.

4. Are data sufficient to proceed with the HHRA? Are there sufficient number of samples, from appropriate media, appropriate locations (representative of exposure areas, capturing most likely areas of contamination), analyzed for all suspected analytes, appropriate data quality - QA/QC checks included, adequate detection limits, available appropriate background data, appropriate sampling methods/ depths, supporting data?

   For Cape May, data are currently insufficient to proceed with the HHRA. It appears existing limited groundwater data were obtained from geoprobe sampling of soil borings over 20 years old. Historical soil/sediment data are also limited. Because of tidal and storm caused erosion and influence on groundwater and tidal intrusion, historical data is unlikely to represent current and future conditions. Cape May is in the Work Plan development phase. The Technical Memorandum recommends sampling to addresses data gaps and meet needs of the risk assessments – surface soil, shallow groundwater, subsurface soil above the water table, and sediment 0-6 inches in depth and not covered by more than 1-2 feet of surface water at mid-tide. Analyze for metals, SVOCs, pesticides, and explosives. Once the samples are collected and analyzed, review of the newly available data will be needed.

5. If answer to above is no, collect additional data as needed. Then review new datasets to determine if data is now adequate to proceed.

   NA: Cape May project in work plan development phase.

6. Compare maximum site concentrations to mean or median background levels. Consider statistical comparisons and development of background threshold values (BTVs), for inclusion in Baseline HHRA if maximum site concentrations exceed background, but are close.

   NA: Cape May project in work plan development phase. Propose background sampling with analysis for metals, SVOCs, and pesticides in soil and background groundwater with analysis for metals and pesticides.

7. If everything is below background, no need to continue in HHRA process. Anything present below background will be excluded from risk calculations.

   For Cape May, evaluate metals, SVOCs, and pesticides in site soil vs background soils, and metals and pesticides in groundwater vs background groundwater. Background threshold values (BTVs) should not be necessary.

8. Screening Level HHRA – compare maximum site concentrations to conservative risk-based screening levels, usually EPA Regional Screening Levels (RSLs) for residential soils and tapwater or maximum contaminant levels (MCLs) and vapor intrusion screening levels (VISLs). For non-carcinogens use RSLs set at Hazard Quotients (HQs) of 0.1.

   At Cape May, screen groundwater against MCLs. For chemicals lacking MCLs, use tap water RSLs. Screen soils against residential RSLs and industrial worker RSLs. There are no VOCs among COPCs, therefore, no screening against VISLs will be required.

9. If site has no exceedances, no need to continue in HHRA process.

   NA: Cape May project in work plan development phase.

10. Evaluate frequency, magnitude, and spatial clustering of exceedances to determine whether an interim removal action could remove the majority of contamination.

    NA: Cape May project in work plan development phase.

11. Is an interim removal action recommended? Are soil and /or sediment exceedances extremely high (generally defined as having concentrations 100x average across other areas of the site) and concentrated in one area such a removal would leave the rest of the site without risks.

    NA: Cape May project in work plan development phase. No soil contamination has been reported in historical investigations. However, as an abandoned dumping station, there is a history of municipal waste disposal. A geophysical survey is proposed to rule out the presence of drums or UXO and determine extent of debris underwater. If drums or UXO are found, the area of the drum(s) or UXO may need investigation as a possible hot spot and a potential interim removal action may be recommended.

12. Interim removal action – perform a removal of limited area(s) of highest contamination

    NA: Cape May project in work plan development phase.

13. Perform confirmatory sampling of sidewalls and bottom of excavation. Confirmatory sample results are then reviewed and passed through the screening steps again to evaluate whether remaining concentrations are below background and screening levels.

    NA: Cape May project in work plan development phase.

14. Update Conceptual Site Model (CSM) – The CSM should be updated as the project progresses, especially at the point of the HHRA process where either no further HHRA is needed, at the conclusion of the refined screening level HHRA, and at the conclusion of the baseline HHRA. It can be included in the Final Remedial Investigation (RI) Report.

    NA: Cape May project in work plan development phase.

15. No further human health risk assessment – This point is reached whenever it is concluded that there are no actionable risks and can be reached when no complete exposure pathways are available, no contamination is present above background, no contamination is present above screening levels, no risks exceed action levels, or there is no basis of action. If no contaminants are present exceeding residential screening levels, the site may be released for unrestricted future use.

    NA: Cape May project in work plan development phase.

16. Proceed to Refined Screening Level HHRA – If contaminant concentrations exceeded screening levels and no interim action is recommended, proceed to a refined screening level HHRA. The Refined Screening Level HHRA can be done using a risk ratio approach, comparing site specific EPCs to EPA risk-based screening levels. Include COPCs exceeding screening levels and COPCs without screening levels.

    NA: Cape May project in work plan development phase.

17. Refined Screening Level HHRA – Retain receptors, exposure pathways, and land uses that were not evaluated in the screening level HHRA or had COPCs exceeding screening levels and/or COPCs without screening levels. Potential receptors for the Refined Screening HHRA are limited to those groups with available default risk-based screening levels and/or those receptors for which screening levels can be developed. If a receptor group is present or could be present in the future and a risk-based screening level is available or can be developed, include this receptor in the refined screening level HHRA risk calculations. Eliminate any receptor/medium not present or screened out during Screening level HHRA.

    At Cape May, no land-uses restrictions or restrictions on groundwater use are in place; however, future use of the AOC for residential or industrial use is not a reasonably foreseeable future use. No buildings are located within the AOC and construction of buildings is not feasible because of the location along the shoreline within the intertidal zone and within the area commonly inundated during king tides and storm surges. Occasional bird-watching groups visit the Site. There is the potential for adolescent trespassers. Groundwater at the site is not currently used as drinking water and is not expected to be used as a drinking water source because of saltwater intrusion. The entire Abandoned Dumping Station is inundated with ocean water ten times per year and much of the area is saturated two times a day, at high tide. There is the potential for construction workers to contact shallow groundwater during excavation work on site. Identified potential receptors include construction workers, adolescent trespassers, and recreational visitors. Screening levels can be developed for construction workers, adolescent trespassers, and recreational visitors.

18. For each receptor, are there appropriate default risk-based screening levels (e.g. RSLs)? Default screening levels use standard generic reasonable maximum exposure (RME) assumptions not adjusted with site specific information. Selected values must be risk-based (e.g. MCLs are not exclusively risk-based and therefore should not be used for this step.) In general, default risk-based screening levels are available for residential and commercial/ industrial workers.

    [The RME is a high-end description of risk defined by EPA guidance (EPA, 1992a) as:

    … a plausible estimate of the individual risk for those persons at the upper end of the risk distribution. The intent of this description is to convey an estimate of risk in the upper range of the distribution, but to avoid estimates which are beyond the true distribution.]

    At Cape May, Screening levels are not available for construction workers and recreational visitors. Use EPA tapwater RSLs to evaluate construction worker shallow groundwater exposures.

19. Identify appropriate default risk-based screening levels (e.g. RSLs). Residents and industrial workers have readily available Regional screening levels (RSLs) and vapor intrusion screening levels (VISLs).

    Not applicable for Cape May.

20. Develop risk-based screening levels for receptors without available default screening levels (e.g. using RSL calculator). Soil RSLs can be developed using the RSL calculator for construction workers and recreational visitors.

    At Cape May, use RSL calculator to develop construction worker soil RSLs and recreational visitor soil RSLs to evaluate soil exposures.

21. Define exposure area(s) are each receptor. This may be the whole site or particular area(s) of the Site depending on land-use and areas of contamination.

    At Cape May, single AOC-wide exposures should be considered for groundwater and for soil.

22. Calculate Exposure Point Concentrations (EPCs). The EPC represents an estimated concentration to which a receptor is assumed to be continuously exposed while in contact with an environmental medium. A conservative estimate of the mean concentration is used as the EPC. The EPC is generally defined as the 95 percent upper confidence limit on the mean (UCL) and is calculated using EPA's ProUCL software. In cases with insufficient number of samples to calculate a 95%UCL or in cases where the 95%UCL exceeds the maximum detected concentration the maximum detected concentration is used as the EPC.

    NA: Cape May project in work plan development phase.

23. Calculate individual COPC Hazard Quotients (HQs) and/or Cancer Risks. Calculate reasonable maximum exposure (RME) non-cancer health hazard quotients (HQs) and cancer risks for each receptor using a risk ratio approach, comparing site specific EPCs to EPA RSLs. Lead is considered separately. The IEUBK and adult lead models are used to estimate child and infant blood lead levels. Average lead concentrations are used as the input to these models. For the refined screening level HHRA, the lead evaluation is limited to a simple comparison of average lead concentrations to lead screening levels.

    NA: Cape May project in work plan development phase.

24. Calculate receptor-specific cumulative Cancer Risks and Hazard Indices (HIs)/ Refine for target organ/systems as appropriate and update CSM. Cancer Risks from multiple contaminants are considered additive. Non-cancer health hazards from multiple contaminants exceeding target threshold of 1 should be refined to present target organ and target system specific HIs. The CSM should be updated at the conclusion of the refined screening level HHRA.

    NA: Cape May project in work plan development phase.

25. Are target risk thresholds exceeded? EPA target risk thresholds include a total organ and target system specific HIs for non-carcinogens equal to 1, and a total cancer risk of 1E-6. Total cancer risks between 1E-6 and 1E-4 require further evaluation. Total cancer risks exceeding 1E-4 require action. EPA's goal for lead is that no more than 5% of exposed children or fetuses will have blood lead levels exceeding 5 µg/dL. For the refined screening level HHRA, the lead evaluation is limited to a comparison of lead soil concentrations to 200mg/kg for child residents and child recreational visitors, comparison of lead soil concentrations to 1,000 mg/kg for workers, and comparison of lead groundwater

concentrations to 15 µg/L. State criteria may differ. Consider criteria for all stakeholder regulators. Are non-cancer organ and target system specific HIs elevated above 1? Are cancer risks in excess of 1E-6? Are lead concentrations above the screening level? If so, look at site-specific lines of evidence.

NA: Cape May project in work plan development phase.

26. Apply site-specific lines of evidence. Look at site-specific lines of evidence, for example: to corroborate estimated risks from vapor intrusion, look at concentrations of contaminants in indoor air and soil gas for evidence of contaminant migration through soil gas and into interior spaces.

    NA: Cape May project in work plan development phase.

27. Are the target risk thresholds exceeded for individual receptors? See note #25 for target risk thresholds.

    At Cape May, use EPA criteria. If no target risk thresholds are exceeded for construction workers and recreational visitors, no further analysis of risk for these receptors is needed. If target risk thresholds are exceeded for any scenario, proceed to baseline HHRA and include scenarios with risk.

28. No Further HH Risk Assessment for receptors with risks at or below target risk thresholds. If risks do not exceed target risk thresholds for any receptor evaluated in the refined screening level HHRA or in the Baseline HHRA, no need to continue evaluation of that receptor in the HHRA process. If no risks are found for residents, the site may be released for unrestricted future use.

    NA: Cape May project in work plan development phase. Potential future residential use is not applicable for this site.

29. Proceed to Baseline HHRA for receptors with risks exceeding target risk thresholds.

    NA: Cape May project in work plan development phase.

30. Baseline HHRA - Retain receptors, exposure pathways, and land uses that were not evaluated in the Refined Screening Level HHRA or had risks exceeding target risk thresholds in the Refined Screening Level HHRA.

    NA: Cape May project in work plan development phase.

31. Exposure assessment – identify current and future Human Receptors (excluding those with risks at or below target risk thresholds during the Refined Screening Level HHRA), exposure areas, media, routes of exposure, exposure assumptions:

    a) Human Receptors
        i. Residents – Not applicable
        ii. Industrial/commercial workers – Not applicable
        iii. Recreational users – bird watchers – with guided access only; potential exposures to surface soil

iv. Construction workers/utility workers – potential exposures to shallow groundwater and soil
v. Trespassers – potential exposures to surface soil and sediment
vi. Fishermen/hunters - None
vii. Other - None

b) Exposure Areas
   i. Single site-wide exposures – groundwater, soil
   ii. Division of site by existing and potential future use – Not applicable
   iii. Division of site by variations in contamination/past history - not applicable

c) Media
   i. Groundwater – shallow groundwater only
   ii. Surface soils – 0-1 ft
   iii. Subsurface soils – 0 ft bgs to water table (approximately 4 ft bgs)
   iv. Sediment – 0-6 inches in depth and not covered by more than 1-2 feet of surface water at mid-tide
   v. Surface water – Not expected- tidal flushing
   vi. Air (indoor air, ambient outdoor air, soil gas) – Not applicable - No VOCs in contaminants of potential concern
      1. For vapor intrusion evaluation, start with shallow groundwater (at the water table), beneath or as close as possible to buildings. If groundwater fails initial screen against VISLs, collect subslab soil gas and indoor air.
      2. This is the one medium where an HHRA commonly drives the collection of more data midway through the process.
   vii. Biota (fish, hunted prey/agricultural products) – Not applicable

d) Exposure Point Concentrations – concentration of chemical that persons might be exposed to
   i. An estimate of the average concentration - Generally 95%UCLs of the mean
   ii. For groundwater, we use a 95%UCL from the “core of the plume” if there is a plume, otherwise 95%UCL from water across the exposure area; limit to 1-2 most recent years of data (RI data only – shallow groundwater only; no plume expected).
   iii. Maximum detected concentrations are used if there is insufficient data to generate 95%UCLs or if the 95%UCL exceeds the maximum – Plan sufficient number of samples for 95%UCL; however, if few detects, maximums may be used.

e) Exposure Routes
   i. incidental ingestion of contaminated soils, potentially complete
   ii. dermal contact with contaminated soils, potentially complete
   iii. inhalation of dust and volatiles from soils, dust pathway potentially complete No volatiles expected
   iv. incidental ingestion of contaminated sediment, potentially complete

v. dermal contact with contaminated sediment, potentially complete
vi. incidental ingestion of contaminated surface water, Not applicable – tidal flushing
vii. dermal contact with contaminated surface water, Not applicable – tidal flushing
viii. ingestion of fish, Not applicable
ix. ingestion of hunted prey, Not applicable
x. ingestion of contaminated groundwater as drinking water, Not applicable
xi. dermal contact with groundwater used as a household water source while showering or bathing, Not applicable
xii. inhalation of vapors from groundwater during household water use, Not applicable
xiii. inhalation of volatile contaminants in groundwater that may volatilize into excavation trenches, considered incomplete at this time due to lack of VOCs
xiv. dermal contact with shallow groundwater in excavation trenches, potentially complete
xv. ingestion of shallow groundwater in excavation trenches, minor pathway, no evaluation
xvi. dermal contact with shallow groundwater in excavation trenches, potentially complete
xvii. inhalation of contaminants in indoor air, Not applicable
xviii. inhalation of volatile contaminants in groundwater that may volatilize into indoor air spaces through vapor intrusion, Not applicable and
xix. ingestion of homegrown fruits and vegetables. Not applicable

f) Exposure Assumptions – i.e. exposure frequency, body weights, ingestion rates, skin surface area, etc. for both reasonable maximum exposure (RME) and central tendency exposures (CTE)
   i. RME assumptions are from the high end of the distribution range and are used to define the highest exposure that is reasonably expected to occur at a site.
   ii. CTE assumptions are from the middle of the distribution range and are used to define the average exposure that is reasonably expected to occur at a site.
   iii. Default assumptions for standard scenarios – use defaults for construction workers
   iv. Site-specific information, develop region specific particulate emission factors (PEFs)
   v. Professional judgement – use professional judgement for recreational and trespasser exposures

32. Toxicological assessment – tiered hierarchy of toxicity value sources
   a) EPA's IRIS database
   b) EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)
   c) Peer-reviewed toxicity values from other sources

NA: Cape May project in work plan development phase.

33. Risk characterization and update CSM – combines exposure assessment and toxicity assessment to yield risk – evaluate both RME and CTE
    a) Calculation of non-cancer hazard quotients and hazard indices, including organ-specific HIs (add hazards for chemicals that act on the same target organ, ie all contaminants that effect the heart would be added together),
    b) Calculation of excess lifetime cancer risks,
    c) Consideration of contaminants that act via a mutagenic mode of action,
    d) Evaluation of lead exposures using models that predict blood lead levels in fetuses and children – use Adult Lead model for workers, adolescent trespassers, and adult recreational visitors
    e) The CSM should be updated at the conclusion of the Baseline HHRA.

    NA: Cape May project in work plan development phase.

34. Are the target risk thresholds exceeded for individual receptors?
    a) compare to organ-specific HIs of 1
    b) compare total cancer risks to EPA's target range of 1E-6 to 1E-4; consider state targets that may differ
    c) compare lead model predictions to EPA's goal of no more than 5% of children with blood lead levels of 5µg/dL

    NA: Cape May project in work plan development phase.

35. Re-examine risk assumptions, incorporate site-specific assumptions, and recalculate risks. Re-examine exposure assumptions. Re-visit data used and exposure assumptions applied in calculating risk to see if they are protective but realistic for the Site. Are there any site-specific changes that can be made to exposure assumptions? Is there any site-specific information that can be used to adjust risk calculations? Apply site specific changes to exposure assumptions and recalculate risk.

    NA: Cape May project in work plan development phase.

36. Are the target risk thresholds exceeded for individual receptors? See Target risk levels in Note #34. Re-examine revised risk levels.

    NA: Cape May project in work plan development phase.

37. Evaluate Uncertainties
    a) All risk assessments entail uncertainties at all stages of the process,
    b) The goal is to use conservative assumptions, such that final results do not **under** estimate risk
    c) Review calculated risks and the uncertainties involved in the calculations
    d) Risk management decisions must be made with the knowledge/understanding of the uncertainties in the process, particularly in cases where the final risks numbers are near the target levels

    NA: Cape May project in work plan development phase.

38. Is there sufficient Basis for Action?

a) The cumulative excess carcinogenic risk to an individual exceeds EPA's target risk range of 1E-06 to 1E-04 (using reasonable maximum exposure [RME] assumptions) for either the current or reasonably anticipated future land use;
b) The non-carcinogenic hazard index is greater than 1 (using RME assumptions) for either the current or reasonably anticipated future land use;
c) Site contaminants cause adverse environmental impacts; or
d) Chemical-specific standards or other measures that define acceptable risk levels are exceeded, and exposure to contaminants above these acceptable levels is predicted for the RME.

NA: Cape May project in work plan development phase.

39. If yes, perform a Feasibility Study

a) Summarize site conditions and risks,
b) Document basis of action,
c) Establish cleanup goals
d) Evaluate alternative clean-up actions

NA: Cape May project in work plan development phase.

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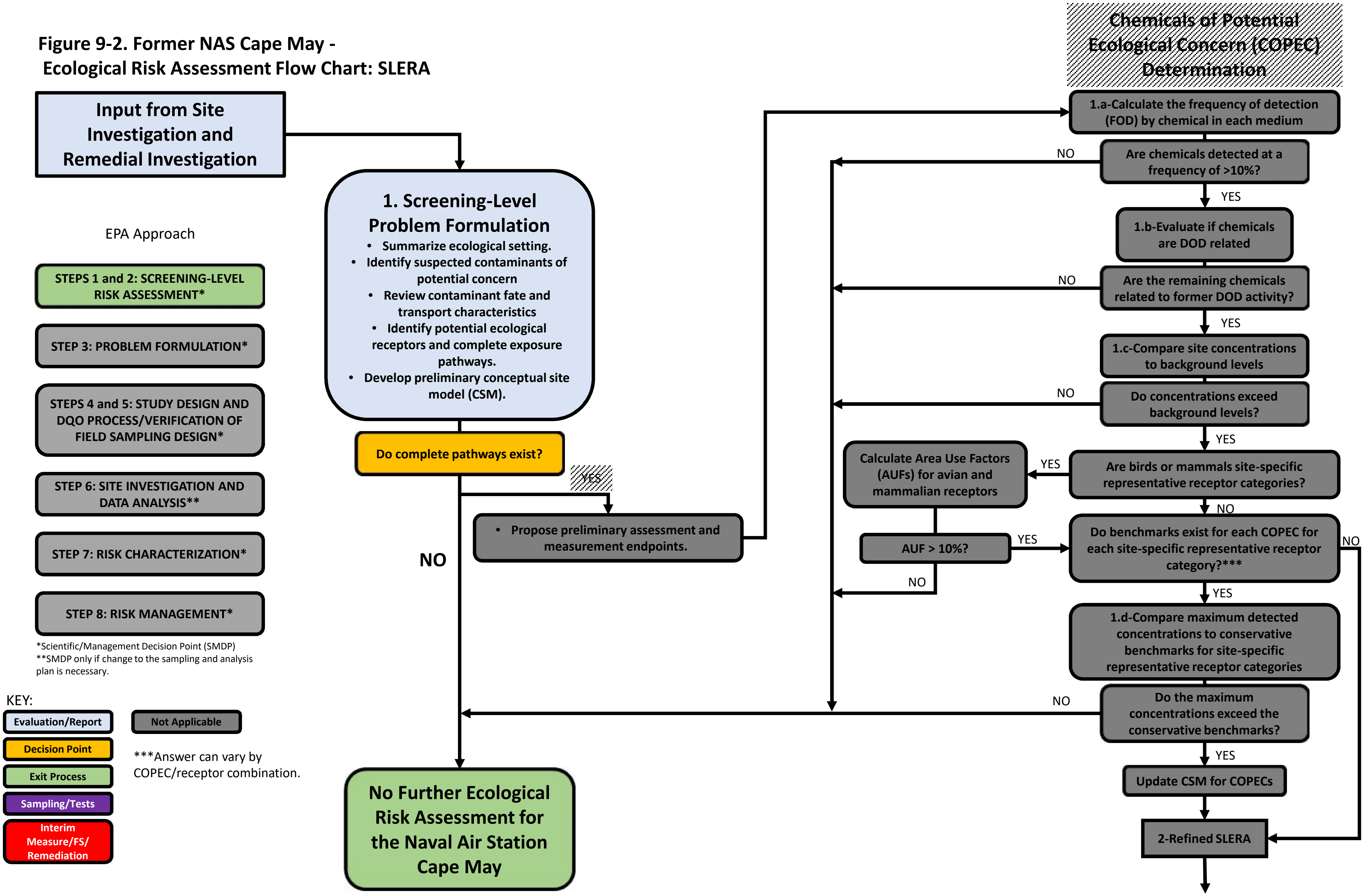
Figure 9-2. Former NAS Cape May - Ecological Risk Assessment Flow Chart: SLERA



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Formerly Used Defense Sites (FUDS)
Remedial Investigation (RI) Work Plan (WP)
Contract Number W912WJ-17-C-0014

Former NAS Cape May
Abandoned Dumping Station (AOC1)
Ecological Risk Assessment Flow Chart Notes
(for Figure 9-2)

BOX #1 Initial SLERA -Screening-Level Problem Formulation

1.

- Summarize ecological site setting
- Identify suspected contaminants or potential concern
- Review contaminant fate and transport characteristics
- Identify potential ecological receptors and complete pathways
- Propose preliminary assessment and measurement endpoints
- Develop preliminary ecological conceptual site model for the site

If complete pathways exist proceed to 1.a, if not, no further ecological risk assessment required. Red type explains considerations for NYOW to date.

Ecological Setting

The Abandoned Dumping Station (AOC 1) is approximately 1 acre in size and is located on the eastern shoreline of NAS Cape May adjacent to the Cape May Inlet (see Figure xxx). The terrestrial portion of AOC 1 is comprised of two distinct habitats: a roughly 200 ft sandy shoreline and a 0.4-acre vegetated area located in the southern portion of the site. The sandy shoreline varies in width from 15 -30 ft and is bordered on the land side by a narrow strip of American beach grass (*Ammophila breviligulata*) and an access road. The sandy beach is highly dynamic ecosystem that is underwater during high tides and storm events, and frequently experiences significant erosion and scouring. The vegetated area in the southern portion of the site is ruderal in nature and is dominated by phragmites (*Phragmites australis*), Johnson grass (*Sorghum halepense*), sheep sorrel (*Rumex acetosella*), curly dock (*Rumex crispus*), seaside goldenrod (*Solidago sempervirens*), American beach grass, seaside spurge (*Euphorbia polygonifolia*), ragweed (*Ambrosia spp.*), and bull thistle (*Cirsium vulgare*). This portion of the site is also somewhat dynamic in that it is flooded daily during high tides, but does not experience erosion and scouring on a daily basis. The substrate for both habitats is composed predominantly of sand.

Due their size and limited vegetation cover, the habitats present do not support diverse semi-aquatic or terrestrial wildlife communities. The most frequently observed resident species are fiddler crabs (*Uca spp.*), sand crabs (*Pagurus arcuatus*), and ghost crabs (*Ocypode quadrata*); in addition, the sandy beach portion of the site historically has served as a horseshoe crab

(*Limulus polyphemus*) spawning area. Therefore, the site also may serve as a limited feeding area for shorebirds during their spring migration.

Contaminants of Potential Ecological Concern

There is limited information available regarding the extent and nature of dumping activities at this site. A study conducted in by Ogden (1998) sampled soil and groundwater for VOCs, SVOCs, pesticides, PCBs, and metals. No contaminant concentrations in soils exceeded soil criteria and no concentrations of VOCs, SVOCs, or PCBs were detected in groundwater. Only low-level detections of DDT and DDE in groundwater were reported above groundwater standards.

Contaminant Fate and Transport

Due to the porous nature of the sand substrate throughout the site; the lack of adsorption material; the constant flushing of the area by tidal and storm activity; and the dynamic movement of sand in and out of the Cape May Inlet (which was dramatically illustrated in the Data Collection Report (Ogden 1998)); it is likely that most of the contaminant material dumped at this site over 40 years ago has been redistributed through erosion and downward percolation and that little if any remains on or near the surface at the site with the possible exception of larger solids (e.g., metal objects, construction debris, etc).

Potential Receptors and Complete Pathways

The resident biotic community present at the site is limited to a few resident species and occasional use by migratory birds and spawning horseshoe crabs because of the habitat size and the dynamic nature of the sand substrate (especially the sandy shoreline). Due to specific spawning requirements of the horseshoe crab (e.g., moderate beach sloping, sufficient oxygenation of the upper sand layer, continuous moisture levels sufficient to prevent egg desiccation), the only portion of the site suitable for horseshoe crab mating and egg laying is the narrow sandy shoreline. Horseshoe crabs lay their eggs at a depth of 2-8 inches below the beach surface; therefore, it is highly unlikely that any historical DOD-related contamination could adversely impact the relatively small number of horseshoe crabs using this portion of the beach for spawning.

Due to the limited likelihood of exposure of ecological receptors at the site to contamination resulting from historical DOD dumping activities that occurred over 40 years ago, a complete exposure pathway of concern is not present and No Further Ecological Risk Assessment activities are required.

TABLES

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Table 1-1. Aerial Photograph Interpretation

Date	Description
1931	The Site was mostly unvegetated, with a building located along the northern shoreline on Cape May Harbor. There was no evidence of the Dumping Station or the two Firing Ranges.
1940	The northern portion of the Site was the same as the 1931 aerial photograph, with building along Cape May Harbor. An airfield consisting of eight runways constructed like spokes in a wheel was present south of the buildings. A building was present north of the Eastern Firing Range location. The Dumping Station appeared to be active. Items are present offshore north of the Dumping Station, which appear to be larger than drums but are not clearly defined.
1951	The northern portion of the Site was similar to the 1940 aerial photograph. The northern runway was extended to the northern shoreline at Cape May Harbor. There appeared to be a disturbed area or landfill in the area between what is now Munro Avenue and Arcus Road and a building was constructed immediately north of this area across Munro Avenue. Both of the Firing Ranges were present. The Dumping Station is present as a debris fan near the center point of the eastern shoreline at Cape May Inlet, which may indicate that erosion was occurring. A series of groins extend from the southern beach into the Atlantic Ocean.
1957	The northern portion of the Site and the airfield appeared similar to the 1951 aerial photograph. The landfill area between Munro Avenue and Arcus Road was vegetated and showed no evidence of activity. The Dumping Station appeared as a fan-shaped bump-out along the inlet. Both of the Firing Ranges appeared to be active.
1961	The northern portion of the Site and the airfield appeared similar to the 1957 aerial photograph. Scattered debris was present along the northern shoreline approximately 0.25 miles south of the harbor and 150 feet west of the wetlands. The Dumping Station appeared inactive. An indoor firing range was present at the Eastern Firing Range. No change was apparent at the Western Firing Range.
1974	The airfield appeared inactive, with buildings constructed on that area. The north-running runway was now a road (now Perchard Avenue). The scattered debris in the area near the wetlands in the northeastern corner of the Site was not present. A new paved area, possibly a test track, east of the buildings along the harbor was present. The area of the landfill between Munro Avenue and Arcus Road was unvegetated but showed no evidence of dumping. Three new buildings were located adjacent to this area to the south. There was no evidence of activity at the Dumping Station. There were no changes at the two Firing Ranges.
1977	The quality of this aerial photograph was poor, but there did not appear to be changes from the 1974 aerial photograph.
1984	The northern portion of the Site appeared to be the same as the 1974 aerial photograph. Along the eastern portion of the Site at the inlet, three manmade ponded areas have been established. The northernmost one is north of Munro Avenue, the middle pond is between Munro Avenue and Arcus Road, and the third ponded area is south of the middle pond and east of Arcus Road. There was no evidence of the former Dumping Station. Both Firing Ranges appeared the same as the 1974 aerial photograph.

Table 1-1. Aerial Photograph Interpretation (Continued)

Date	Description
1991	The Site appeared mostly the same as the 1984 aerial photograph. The target berm for the Western Firing Range was against the beach at its western end. There appeared to be significant erosion in the vicinity of the Western Firing Range.
1995	The quality of this aerial photograph was poor, but the Site appeared to be similar to the 1991 aerial photograph.
2006	Overwash had occurred on the Atlantic Ocean side of the Site, with sands pushed back onto what was once the southern portion of the airfield. The target berm for the Western Firing Range was not visible.
2010	Most of the Site appeared to be unchanged. The target berm for the Western Firing Ranges was visible on the beach. The two southernmost manmade ponded areas first viewed in the 1984 aerial photograph had merged.
2013	The Site appeared the same as the 2010 aerial photograph.
2017	Most of the Site appears to be the same as the 2013 aerial photograph. The groins that were present along the Atlantic Ocean shoreline in the 1957 aerial photograph were visible below the water surface. The beach had migrated closer to the Former Eastern Firing Range. The Former Western Firing Range was no longer visible, as the beach had migrated further inland and vegetation covered the remaining area.

Table 1-2. FUDS HTRW Eligibility Matrix

Location	Is the area still owned or operated by DoD?	Was the property transferred from DoD control before 17 October 1986?	Has the area been altered or beneficially used by the current owner?	Does contamination post-date DoD use?	Has restoration already been initiated?	Is it MMRP, BD/DR or CON/HTRW?	Eligibility Determination
AOC 1 – Abandoned Dumping Station	No	Yes	No	No	No	No	Yes, this site is eligible for consideration under FUDS HTRW
AOC 2 – Former Eastern Firing Range	No	Yes	Yes	Yes	Yes	No	No, this site is not eligible for consideration under FUDS HTRW
AOC 3 – Former Western Firing Range	No	Yes	Yes	Yes	No	No	No, this site is not eligible for consideration under FUDS HTRW

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Table 5-1. Abandoned Dumping Station - Soil Analytical Data (Ogden, 1998)

	Current USEPA Residential Soil RSLs[1]	Current USEPA Industrial Soil RSLs[1]	USEPA ECO-SSL[2]	NJ Background Values for Urban Coastal Plain [3]	DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01
				Sample ID	DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02 (DUP)	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01
				Sample Date	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997
				Sample Depth	1 ft	2 ft	2 ft	2 ft	3.5 ft	2 ft	3.5 ft	2 ft	3 ft
				Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Volatile Organic Compounds:													
Methylene Chloride	57.0	1,000	N/A	N/A	0.2200 B	0.3600 B	0.2300 B	0.2400 B	0.1400 B	0.1500 B	0.1400 B	0.1400 B	0.2000 B
Semivolatile Organic Compounds:													
Anthracene	18,000	230,000	29.0 (i)	N/A	0.0088 J	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Benz(a)anthracene	1.10	21.0	1.1 (m)	N/A	0.0370	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Benzo(a)pyrene	0.110	2.10	1.1 (m)	N/A	0.0320	<0.0200	<0.0190	<0.0170	<0.0180	0.0110 J	<0.0180	<0.0180	<0.0190
Benzo(b)fluoranthene	1.100	21.0	1.1 (m)	N/A	0.0590	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Benzo(g,h,i)perylene	N/A	N/A	1.1 (m)	N/A	0.0200	<0.0200	<0.0190	<0.0170	<0.0180	0.0170 J	<0.0180	<0.0180	<0.0190
Benzo(k)fluoranthene	11.0	210	1.1 (m)	N/A	0.0210	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Chrysene	110	2,100	1.1 (m)	N/A	0.0480	<0.0200	<0.0190	<0.0170	<0.0180	0.0120 J	<0.0180	<0.0180	<0.0190
Fluoranthene	2,400	30,000	1.1 (m)	N/A	0.0850	<0.0200	<0.0190	<0.0170	<0.0180	<0.0250	<0.0180	<0.0180	<0.0190
Indeno(1,2,3-ed)pyrene	1.100	21.0	1.1 (m)	N/A	0.0200	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Phenanthrene	N/A	N/A	29.0 (i)	N/A	0.0250	<0.0200	<0.0190	<0.0170	<0.0180	<0.0170	<0.0180	<0.0180	<0.0190
Pyrene	1,800	23,000	1.1 (m)	N/A	0.0520	<0.0200	<0.0190	0.0900 J	<0.0180	0.0200	<0.0180	<0.0180	<0.0190
Phenol	19,000	250,000	N/A	N/A	<0.3700	<0.4000	<0.3800	<0.3400	0.0110 J	<0.3400	<0.3700	<0.3500	<0.3800
Pesticide Compounds:													
4,4'-DDD	1.90	9.60	0.021 (m)	N/A	0.0073	<0.0040	<0.0038	<0.0034	<0.0037	<0.0034	<0.0037	0.0085	<0.0038
4,4-DDE	2.00	9.30	0.021 (m)	N/A	0.0160	0.0044	0.0039	0.0011	<0.0037	<0.0034	<0.0037	0.0440	0.0180
4,4-DDT	1.90	8.50	0.021 (m)	N/A	0.0042	<0.0040	<0.0038	0.0052	<0.0037	<0.0034	<0.0037	0.0410	0.0082
Metals:													
Aluminum	77,000	1,100,000	N/A	10,800	6.010 *	3.360 *	2.700 *	0.9310 *	1.450 *	2.310 *	1.980 *	5.140 *	1.400 *
Arsenic	0.68	3.00	18.0 (p)	13.6	0.0067	0.0019	0.0020	0.0017	0.0015	0.0024	0.0230	0.0037	0.0011 B
Barium	15,000	220,000	330 (i)	65.8	0.0203 B	0.0118 B	0.0141 B	0.0383 B	0.0238 B	0.0124 B	0.0090 B	0.0214 B	0.0021 B
Beryllium	160	2,300	21.0 (m)	0.68	0.0002 B	0.0011 B	0.0007 B	<0.0001	<0.0001	0.0001 B	<0.0001	0.0001 B	<0.0001
Calcium	N/A	N/A	N/A	2,000	0.8680 B	0.8780 B	0.7170 B	0.3930 B	0.3880 B	0.4000 B	0.4480 B	0.6430 B	0.3190 B
Chromium	N/A	N/A	26.0 (a)	34.7	0.0203 *	0.0082 *	0.0067 *	0.0037 *	0.0041 *	0.0059 *	0.0055 *	0.0127 *	0.0024 *
Cobalt	23	350	13.0 (p)	< 5.0	0.0024 B	0.0022 B	0.0020 B	0.0007 B	0.0007 B	0.0008 B	0.0009 B	0.0022 B	0.0065 B
Copper	3,100	47,000	28.0 (a)	33.3	0.0100	0.0047 B	0.0041 B	0.0296	0.0052 B	0.0243	0.0080	0.0097	0.0026 B
Iron	55,000	820,000	N/A	21,100	10.10 *	5.070 *	4.590 *	1.710 *	2.350 *	3.660 *	3.250 *	9.010 *	1.500 *
Lead	400	800	11.0 (a)	144	0.0170 *	0.0025 *	0.0022 *	0.0159 *	0.0022 *	0.0154 *	0.0019 *	0.0070 *	0.0038 *
Magnesium	N/A	N/A	N/A	1,870	2.020	1.230	1.020 B	0.3660 B	0.5150 B	0.6460 B	0.7530 B	1.6500	0.2880 B
Manganese	1,800	26,000	220 (p)	206	0.0706 *	0.0434 *	0.0353 *	0.0224 *	0.0262 *	0.0235 *	0.0266 *	0.0661 *	0.0152 *
Mercury	11.0	46.0	N/A	0.21	0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	N/A	N/A	38.0 (p)	12.3	0.0076 B	0.0054 B	0.0052 B	0.0015 B	0.0020 B	0.0002 B	0.0026 B	0.0056 B	0.0034 B
Potassium	N/A	N/A	N/A	1,750	1.010 B	0.6030 B	0.5230 B	0.1770 B	0.2570 B	0.3520 B	0.3720 B	0.8210 B	0.1300 B
Silver	390	5,800	4.2 (a)	<1.0	0.0005 B	<0.0029	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0004 B	<0.0003
Sodium	N/A	N/A	N/A	< 500	0.3360 B	0.1720 B	0.1480 B	<0.1050	0.1140 U	0.2030 B	0.1470 B	0.3130 B	0.1690 B
Vanadium	390	5,800	7.8 (a)	35.5	0.0217	0.0092 B	0.0073 B	0.0033 B	0.0040 B	0.0065 B	0.0057 B	0.0165	0.0024 B
Zinc	23,000	350,000	46.0 (a)	106	0.0471	0.0319	0.0324	0.0520	0.0267	0.0128	0.0106	0.0292	0.0017

NOTES:

N/A = Not Available

[1] USEPA Regional Screening Levels (RSLs) Table, USEPA, May 2018. For non-carcinogens except lead, value shown is equal to HI=1.0. Carcinogenic values equal to 1x10-6.

[2] USEPA Ecological Soil Screening Levels (ECO-SSLs), February 2005 - April 2008. (a) = Avian; (i) = Soil Invertebrates; (m) = Mammalian; (p) = Plants

[3] NJDEP Ambient Levels of Metals in New Jersey Soils, May 2003. 90th Percentile.

Data Qualifiers:

*=Duplicate analysis not within control limits

B: For organics, analyte detected in laboratory blank as well as sample; indicative of possible laboratory contamination.

For metals, reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL).

J: Estimated value. Result is less than the specified quantitation limit, but greater than zero.

N: Spiked sample recovery not within control limits.

Screening Versus Current USEPA Criteria (1,2):

Orange shaded values represent exceedance of residential RSLs.

Blue shaded values represent exceedance of industrial RSLs.

Green shaded values represent exceedance of ECO-SSLs.

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Table 5-2. Abandoned Dumping Station - Groundwater Analytical Data (Ogden, 1998)

	Current USEPA MCLs[(1)]	Current USEPA Tap Water RSLs[(1)]	DS-B1-GW-01	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02	DS-B3-GW-01	DS-B3-GW-02
		Sample ID	DS-B1-GW-01	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02 (DUP)	DS-B3-GW-01	DS-B3-GW-02 (DUP)
		Sample Date	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997	10/16/1997
		Matrix	Total	Dissolved	Total	Total	Dissolved	Dissolved
		Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Volatile Organic Compounds:								
Toluene	1.00	1.10	<0.0010	--	<0.0010	0.0070 J	--	--
Pesticide Compounds:								
4,4-DDE	N/A	0.00005	<0.00005	--	0.000130	0.000095	--	--
4,4-DDT	N/A	0.00023	<0.00005	--	0.000160	0.000110	--	--
Metals:								
Aluminum	0.050 to 0.200 (s)	20.00	3.0900 N	<0.0746 N	***57.00*** N	19.20 N	0.4190 N	0.5210 N
Antimony	0.0060	0.0078	<0.0053	<0.0053	0.0162	0.0176	0.0151	0.0090 B
Arsenic	0.0100	0.0001	0.0048	<0.0034	***0.0391***	***0.0185***	<0.0034	0.0037 B
Barium	2.000	3.800	0.0400 B	0.0300 B	0.3030	0.1240 B	0.0294 B	0.0315 B
Beryllium	0.0040	0.0250	<0.0003	<0.0003	0.0030	0.0012 B	<0.0003	<0.0003
Cadmium	0.0092	0.0100	<0.0004	<0.0004	***0.0580 B***	0.0005 B	<0.0004	<0.0004
Calcium	N/A	N/A	236.0	242.0	68.10	78.50	82.50	82.50
Chromium	0.1000 (total)	0.00004 (VI)	0.0091 B	<0.0017	***0.2300***	0.0547	0.0034 B	0.0054 B
Cobalt	N/A	0.0060	0.0024 B	<0.0013	0.0304 B	0.0104 B	0.0043 B	0.0058 B
Copper	1.300	0.8000	0.0063 B	0.0257	0.3980	0.2450	0.1020	0.1170
Iron	0.3000 (s)	14.00	7.070	1.540	***83.80***	***23.50***	1.640	1.320
Lead	0.0150	0.0150	<0.0022	<0.0022	***0.3270***	***0.0761***	<0.0022	<0.0022
Magnesium	N/A	N/A	199.0	209.0	114.0	128.0	134.0	134.0
Manganese	0.0500 (s)	0.4300	***1.640***	***1.720***	***1.610***	***1.350***	***1.310***	***1.310***
Mercury	0.0020	0.0006	<0.0001	<0.0001	0.00095	0.00073	0.0002 B	0.0002
Nickel	N/A	0.3900	0.0139 B	0.0128 B	0.1290	0.0452	0.0346 B	0.0267 B
Potassium	N/A	N/A	51.40	54.00	59.60	60.60	59.80	60.50
Silver	N/A	0.0940	<0.0012	<0.0012	0.0016 B	<0.0012	<0.0012	<0.0012
Sodium	0.1000 (s)	N/A	1,110	1,200	1,040	1,170	1,200	1,220
Vanadium	N/A	0.0860	0.0083 B	<0.0025	0.1210	0.0441 B	<0.0025	0.0038 B
Zinc	5.000 (s)	6.000	0.0394	0.0315	1.470	0.7410	0.1700	0.1990

Notes:

N/A = Not Available

(s) = Secondary MCL

(1) USEPA Regional Screening Levels (RSLs) Summary Table, USEPA, May 2018. Maximum Contaminant Levels (MCLs) and Tap Water RSLs.

Data Qualifiers:

B: For organics, analyte detected in laboratory blank as well as sample; indicative of possible laboratory contamination.
For metals, reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL).

J: Estimated value. Result is less than the specified quantitation limit, but greater than zero.

N: Spiked sample recover not within control limits.

Screening Versus Current USEPA Criteria (1):

Blue shaded values represent exceedance of MCLs; bold and italic indicates exceedance of MCLs and Tap Water RSLs.

Orange shaded values represent exceedance of Tap Water RSLs.

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Table 8-1. Former NAS Cape May Sampling Rationale

HTRW AOC#	AOC Name	Historical Site Activities	Current Site Use	Potential AOC-Specific Contaminants	Historical Sampling Results[1,2]	Potential Release to Environment	Media	# Surface Soil (SS) Sample Locations	# Sediment (SED) Sample Locations	# Subsurface Soil (SB) Samples	# Groundwater (GW) Samples	AOC-Specific Analytes	Sampling Approach
1	Abandoned Dumping Station	Site of potential dumping and disposal during DoD use of the site from 1918 to 1946	Undeveloped shoreline; restricted access on military installation; site of occassional escorted bird-watching tours	SVOCs (PAHs), pesticides, explosives compounds, and metals	Ogden (1997) – soil and groundwater samples collected via direct push technology (DPT)/Geoprobe® rig <u>Soil</u>: pesticides – DDT and DDE (above Eco-SSLs); metals below comparison criteria <u>Groundwater</u>: metals – aluminum, arsenic, cadmium, chromium, cobalt, iron, lead, manganese, and mercury (above MCLs and/or tap water RSLs); pesticides – DDE (above tap water RSL)	Spills to surface soil and subsurface disposal; overland flow to surface water/ sediment; leaching to subsurface soil and groundwater	Subsurface soil; surface soil; sediment; and, groundwater (surface water not evaluated due to proximity to the ocean and tidal intrusion)	Up to 15	Up to 15	Up to 15 SB samples from test pits and 10 SB from soil borings	Up to 5	TCL SVOCs (EPA Method 8270, with SIM for low-level PAHs); TCL pesticides (EPA Method 8080); TAL metals (EPA Method 6010/6020 and 7470/7471, dissolved and total for GW); and, explosives compounds (EPA Methods 8330B)	Potential exists for contamination of SS, SB, SED, and GW from solvents, POL, and metals from historical dumping/disposal activities at the Former Dumping Station. The approximate 2-acre site is located along the shoreline of the Cape May Inlet, with approximately half of AOC 1 is now underwater due to shoreline erosion. A phased approach is planned. **<u>Phase I</u>**: <u>Geophysical Investigation</u> - Both land electromagnetic (EM) and ground penetrating radar (GPR) and aerial magnetometry surveys are planned to define the extent of the buried waste materials. Sampling locations will be selected based on the results of the geophysical surveys. <u>Test Pits</u> - A total of three test pits are proposed to determine the nature and extent of the buried debris, through visual inspection and chemical sampling. Up to five subsurface soil samples will be collected from each of the test pits (one from each side wall of each pit, and one from the base of each pit). Total test pit depths are expected to be less than 4 ft, based on depth to groundwater. **<u>Phase II</u>:** <u>Subsurface Soil</u> - Up to five borings will be collected via DPT. Two subsurface soil samples are proposed for chemical analysis from each DPT boring: one shallow sample (from 1 to 2-ft below ground surface, bgs) and one deeper sample (from 2 to 4-ft bgs). Background samples for subsurface soil will be obtained from the borings selected for installation of upgradient background monitoring wells. <u>Surface Soil</u> - Up to 15 discrete (grab) surface soil samples will be collected manually using a hand trowel or hand auger, at depths of 0-12 inches bgs. Background surface soil samples will be collected in the same manner as the Site samples, from up to five background locations in uncontaminated areas outside the influence of the Site, with similar physical conditions (soil type, soil color, vegetative cover, forest canopy, drainage, elevation, etc.). <u>Sediment</u> - Up to 15 sediment samples will be collected from 0-6 inches bgs (and not covered by more than 1-2 feet of surface water at mid-tide), using a Petit Ponar grab sampler, or equivalent. Background samples may not be able to be collected for sediment, because it will be very difficult to find a nearby sediment location that is not potentially impacted. If an appropriate location is found, up to five background sediment samples will be collected. <u>Groundwater</u> - Up to five new permanent groundwater monitoring wells will be installed at AOC 1, using a DPT rig. Groundwater samples will be collected from each of the newly installed wells. In addition to the five new monitoring wells at AOC 1, two upgradient background wells will be installed and sampled.

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APPENDIX A

Aerial Photographs

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Cape May

1 Munro Ave

Cape May, NJ 08204

Inquiry Number: 5447045.1

October 09, 2018

The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

10/09/18

Site Name:

Cape May
1 Munro Ave
Cape May, NJ 08204
EDR Inquiry # 5447045.1

Client Name:

Bluestone Environmental Group
675 Lancaster Ave
Berwyn, PA 19312
Contact: Melissa Myers

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

Search Results:

Year	Scale	Details	Source
2017	1"=750'	Flight Year: 2017	USDA/NAIP
2013	1"=750'	Flight Year: 2013	USDA/NAIP
2010	1"=750'	Flight Year: 2010	USDA/NAIP
2006	1"=750'	Flight Year: 2006	USDA/NAIP
1995	1"=750'	Flight Date: March 25, 1995	USGS
1991	1"=750'	Acquisition Date: March 09, 1991	USGS/DOQQ
1984	1"=750'	Flight Date: August 26, 1984	USDA
1982	1"=1000'	Flight Date: November 16, 1982	USGS
1977	1"=750'	Flight Date: March 17, 1977	USGS
1974	1"=750'	Flight Date: March 15, 1974	EDR Proprietary Aerial Viewpoint
1961	1"=750'	Flight Date: April 30, 1961	EDR Proprietary Aerial Viewpoint
1957	1"=750'	Flight Date: April 30, 1957	USGS
1951	1"=750'	Flight Date: February 25, 1951	EDR Proprietary Aerial Viewpoint
1940	1"=750'	Flight Date: April 10, 1940	EDR Proprietary Aerial Viewpoint
1931	1"=750'	Flight Date: January 01, 1931	EDR/EdrAerials

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

INQUIRY #: 5447045.1

YEAR: 2017

= 750'

N

INQUIRY #: 5447045.1

YEAR: 2013

= 750'

N

EDR®

INQUIRY #: 5447045.1

YEAR: 2010

= 750'

N

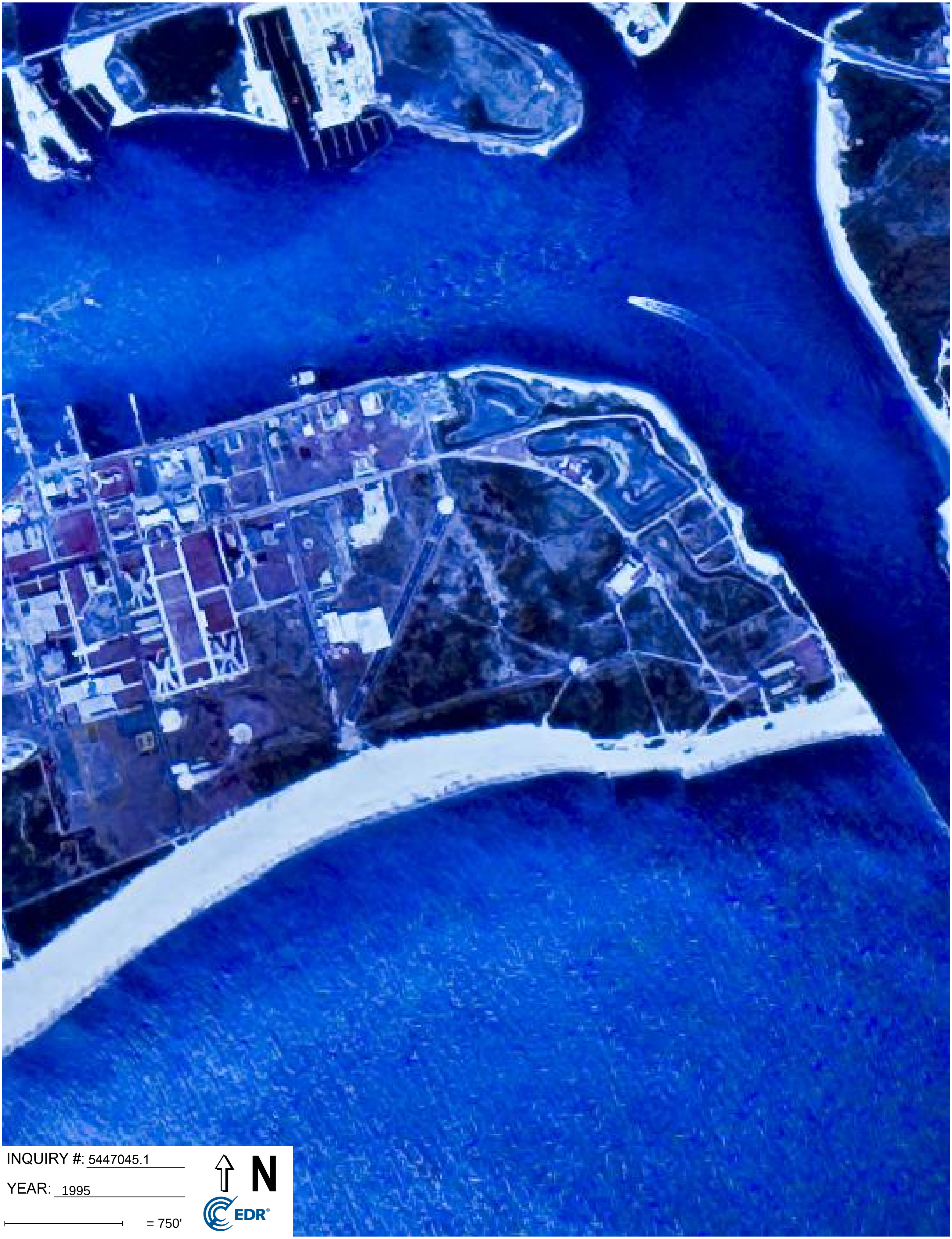
INQUIRY #: 5447045.1

YEAR: 2006

= 750'

N

EDR



INQUIRY #: 5447045.1

YEAR: 1995

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1991

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1984

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1982

= 1000'

N

EDR®

Subject boundary not shown because it exceeds image extent or image is not georeferenced.

INQUIRY #: 5447045.1

YEAR: 1977

= 750'

N

EDR

INQUIRY #: 5447045.1

YEAR: 1974

= 750'

N

EDR

INQUIRY #: 5447045.1

YEAR: 1961

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1957

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1951

= 750'

N

INQUIRY #: 5447045.1

YEAR: 1940

= 750'

N

EDR®

INQUIRY #: 5447045.1

YEAR: 1931

= 750'

N

EDR

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APPENDIX B

Inventory Project Report (INPR)

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DEPARTMENT OF THE ARMY
NEW YORK DISTRICT, CORPS OF ENGINEERS
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, N.Y. 10278-0090

REPLY TO
ATTENTION OF

0 9 JUL 1994

CENAN-EN-IR (200-1a)

MEMORANDUM FOR COMMANDER, BALTIMORE DISTRICT
ATTN: CENAB-EN-HN

SUBJECT: DERP-FUDS Inventory Project Report (INPR) for site No. C02NJ0951, Naval Air Station - Cape May, Cape May, New Jersey.

1. This INPR reports on the DERP-FUDS preliminary assessment of former Naval Air Station - Cape May, Cape May, New Jersey. A site visit was conducted on 25 June 1993. The site survey summary sheet and site map are in Encl 1.

2. We determined that site was formerly used by the U.S. Navy as a training facility, airport and submarine base. A recommended Findings and Determination of Eligibility is in Encl 2.

3. We also determined that there is possible evidence of hazardous/toxic waste and ordnance present at the site eligible for cleanup under DERP-FUDS. The category of hazards are HTRW and OEW. The project summary sheets, EPA FORM 2070-12, Risk Assessment Procedures, back-up estimate, site study and DD Form 1391 are in Encl 3, 4, 5, 6, 7, 8, and 9 respectively.

4. I recommend that you:

a. Review this INPR and recommend action for possible HTRW on this site.

b. Forward your recommendation to CENAD-PL and CEMRD.

5. I also recommend that subsequent to the above action, CENAD;

a. Approve and sign the Findings and Determination of Eligibility;

SUBJECT: DERP-FUDS Inventory Project Report preliminary assessment of former Naval Air Station - Cape May, Cape May, New Jersey.

(continuation)

b. Forward a copy of this INPR to CEHND for further investigation of possible OEW at the former Naval Air Station - Cape May. All proposed investigation and or remedial activities at the site shall be coordinated with CEHND.

9 Encls.

THOMAS A. YORK
COL, EN
Commanding

SITE SURVEY SUMMARY SHEET
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
8 July 1993

SITE NAME: Naval Air Station - Cape May

LOCATION: Cape May, New Jersey

SITE HISTORY: The site is located in the City of Cape May, Cape May County, New Jersey. As per deed dated 2 December 1918 and Declarations of Taking dated 16 July 1941 and 24 June 1942, the Government did obtain 426.774 acres fee. From 1916 to 1946, the Navy ultilized the site as a training facility, airport and submarine base. On 1 June 1946, the Secretary of the Navy conveyed 426.774 acres fee to the United States Coast Guard. Since 1946, approximately 101.814 acres has been lost to erosion and other forces of nature. At the present time the United States Coast Guard is still the owner of record of the site.

SITE VISIT: A site visit was conducted on 25 June 1993. Mr. Constancio J. Labeste and Honesto Castaneda of CENAN-EN-IR visited the site in Cape May, New Jersey. Our point of contact is Commander Geoffrey L. Abbott, Commanding Officer U.S. Coast Guard Training Center, Cape May, New Jersey 08204 [(609) 898-6945]. In the course of our investigation with John Herr, Chief Design Section we found the following: fourteen (14) formerly used buildings or structures (beneficially used by the current owner) out of one hundred five (105) erected at the site, locations of the two former firing ranges area, one former abandoned dumping site and locations of eleven (11) formerly used ammunition bunkers (beneficially used by the current owner). A total of thirteen (13) different sizes underground fuel storage tanks were removed and disposed in accordance with the State of New Jersey Department of Environmental Protection and Energy (DEPE) requirements. Base on our findings we are recommending further investigation for possible evidence of hazardous/toxic waste and ordnance at the site. Therefore; we are proposing the following projects HTRW and OEW.

CATEGORY OF HAZARD: HTRW and OEW

PROJECT DESCRIPTION: There are two (2) potential projects at this site.

Encl

SITE SURVEY SUMMARY SHEET
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
8 July 1993

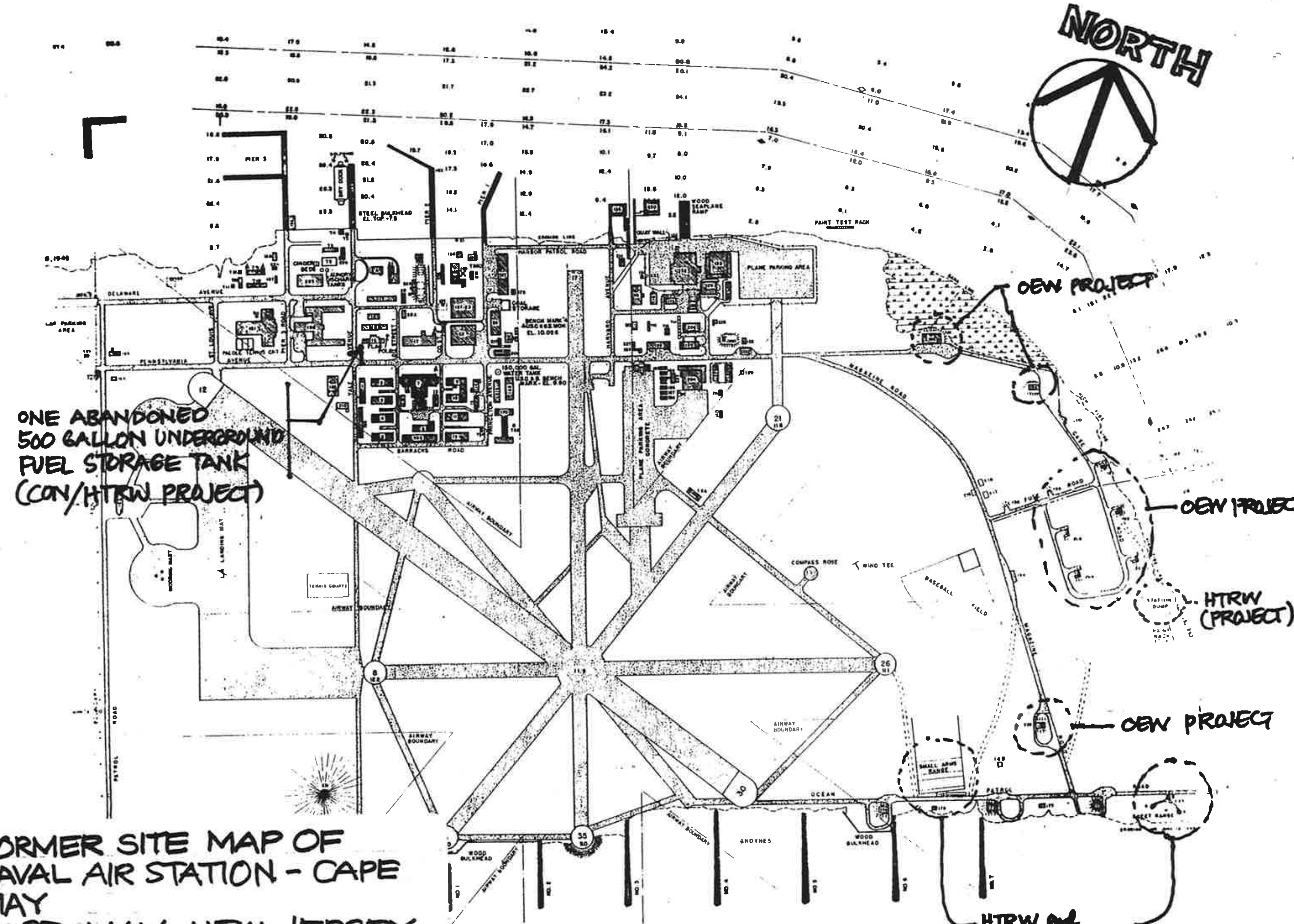
(continuation)

a. HTRW. Location of one abandoned dumping station and two firing ranges (for location see site map on Encl 1).

b. OEW. Locations of eleven (11) formerly used ammunition bunkers, two former firing ranges and surrounding beaches (for location see site map on Encl 1). Evidence findings of OEW at former firing ranges and ordnance offshore by a local fisherman in 1970.

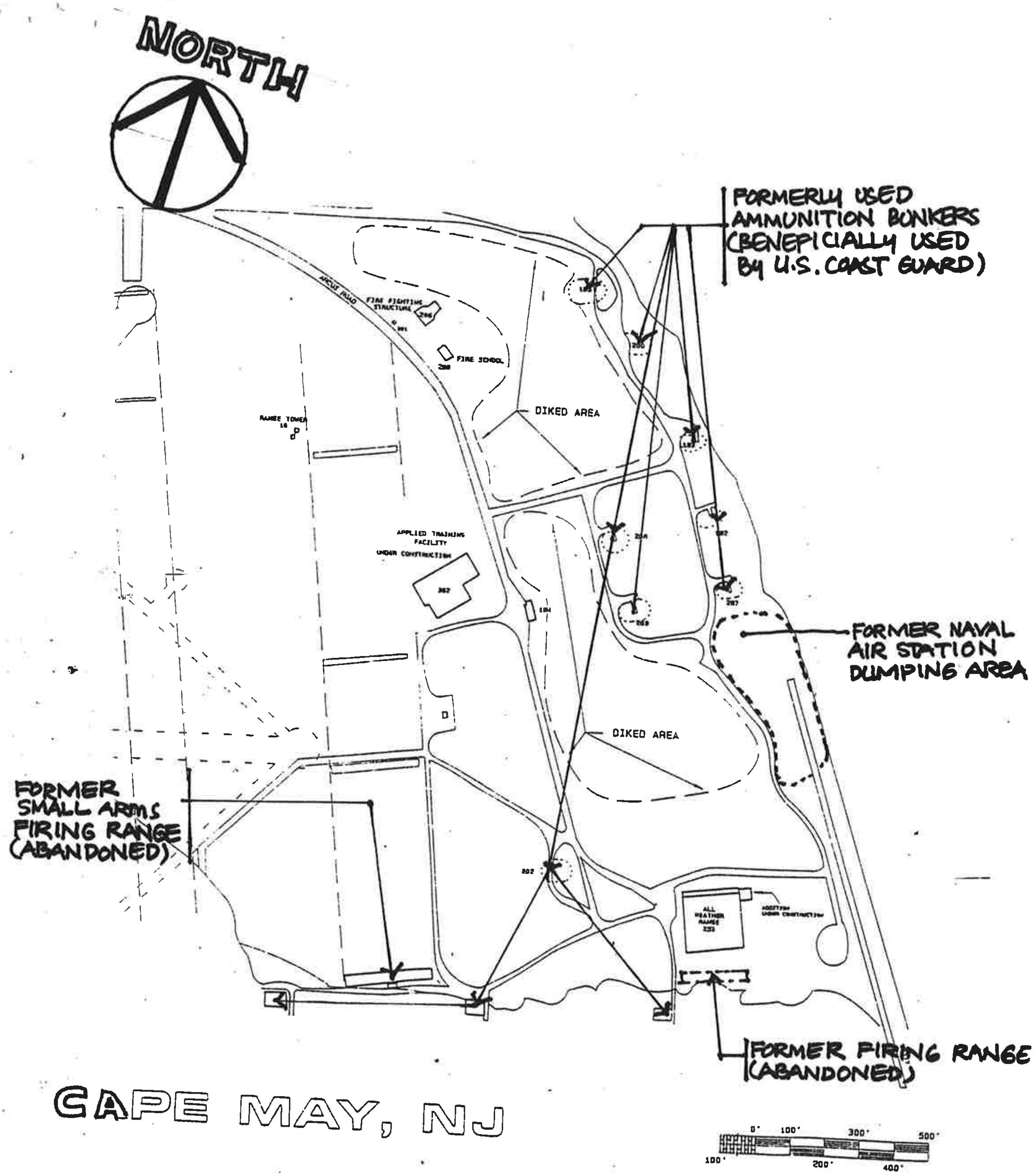
AVAILABLE STUDIES: See DAMES and MOORE final report " Hazardous Materials Survey " of soil and groundwater investigation conducted in the area of formerly used Building 190 in Encl 9. No studies available for dumping station, firing ranges and ammunition bunkers.

PA POC: Mr. Constancio J. Labeste, (212) 264-6070/71 is the New York District POC.



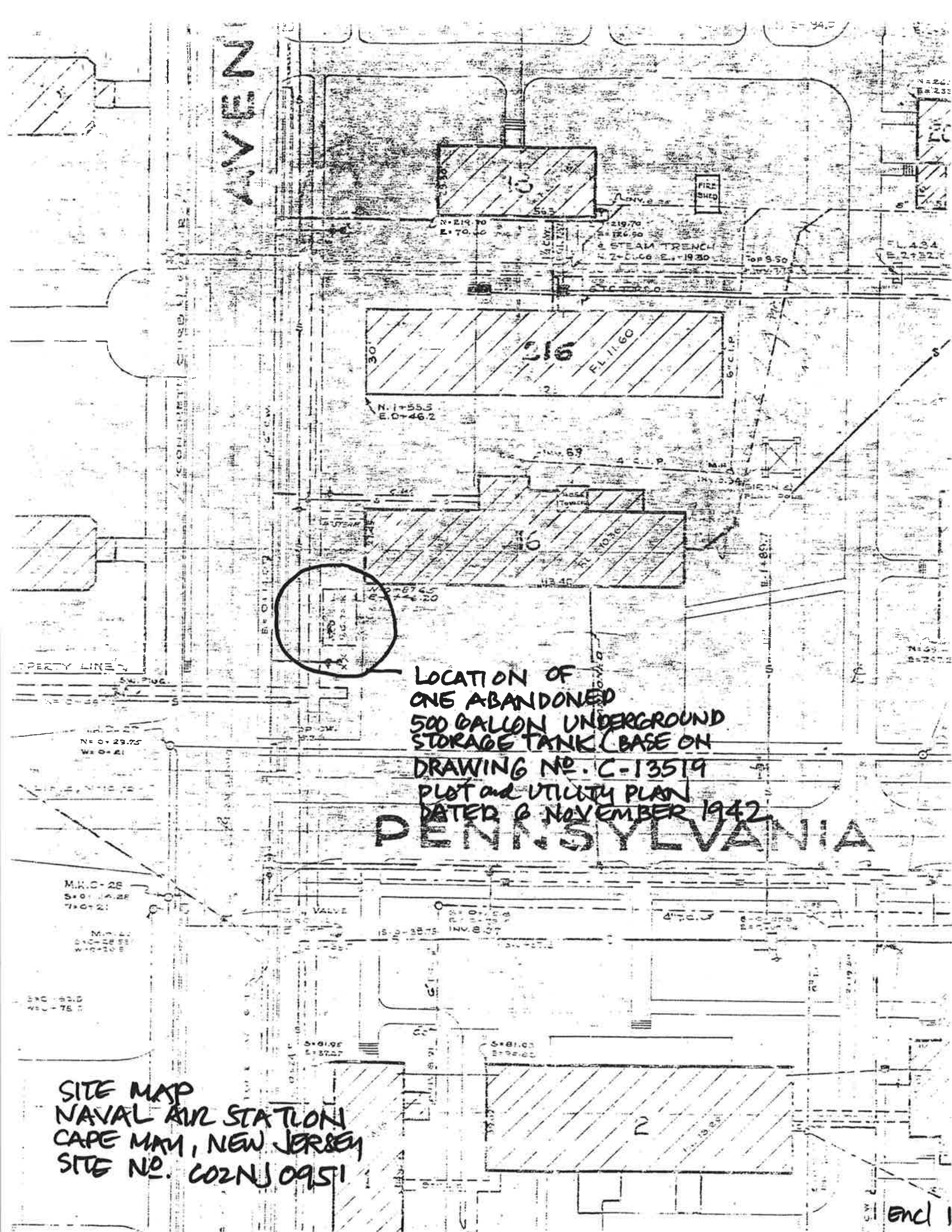
FORMER SITE MAP OF NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951

Encl



FORMER SITE MAP OF
NAVAL AIR STATION - CAPE
MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951

Encl 1



AVEN
FIRE SHED
STEAM TRENCH
216
FL. 11.60
6
PROPERTY LINE
PENNSYLVANIA
VALVE
2
LOCATION OF ONE ABANDONED 500 GALLON UNDERGROUND STORAGE TANK (BASE ON DRAWING No. C-13519 PLOT and UTILITY PLAN DATED 6 NOVEMBER 1942
SITE MAP
NAVAL AIR STATION
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951
Encl 1

DEFENSE ENVIRONMENTAL RESTORATION PROGRAM
FORMERLY USED DEFENSE SITES PROGRAM
FINDINGS AND DETERMINATION OF ELIGIBILITY

NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY

Site No. C02NJ0951

FINDINGS OF FACT

1. The Naval Air Station - Cape May is located in the City of Cape May, Cape May County, State of New Jersey. As per deed dated 2 December 1918 and Declarations of Taking dated 16 July 1941 and 24 June 1942, the Government did obtain 426.774 acres fee.

2. From 1918 to 1946, this site has been used by the Navy as a training facility, airport and submarine base. There is no historical file available for this installation.

3. As per Secretarial Transfer dated 1 June 1946, the Secretary of the Navy conveyed 426.774 acres fee to the United States Coast Guard. As per Assessors Office, City of Cape May, the Coast Guard is still the owner of record of the site. The former Naval Air Station - Cape May is shown on the City of Cape May Tax Map (No. 115) as Block 1218, Lots 1 and 2 and also a portion of Block 1000, Lot 68.

Since 1946, approximately 101.814 acres has been lost to erosion because of storms and other forces of nature.

DEFENSE ENVIRONMENTAL RESTORATION PROGRAM
FOR FORMERLY USED DEFENSE SITES
FINDINGS AND DETERMINATION OF ELIGIBILITY
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951

DETERMINATION

Based on the foregoing findings of fact, the site has been determined to be formerly used by the DOD. Therefore, it is eligible for the Defense Environmental Restoration Program for Formerly Used Defense Sites established under 10 USC 2701 et seq.

Recommended for Signature:

7 July 1994
Date

THOMAS A. YORK
COL, EN
Commanding

Approval:

Date

PAUL Y. CHINEN
Brigadier General, USA
Commanding

PROJECT SUMMARY SHEET
FOR
DERP-FUDS HTRW PROJECT No. C02NJ095101
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951
8 July 1993

PROJECT DESCRIPTION: The project consists of the following former area locations: two (2) former firing ranges areas and one abandoned former dumping station (for location see site map Encl 1). Dumping station shown on old station map, no available studies.

PROJECT ELIGIBILITY: All of the above are the result of Navy activity at the site and are, therefore, eligible for cleanup under the DERP-FUDS program.

POLICY CONSIDERATIONS: There is no policy which prohibits the proposal of this project. The project consisting of areas listed above on project description are eligible for DERP-FUDS if it poses a health hazard.

PROPOSED PROJECT: The proposed project consists of installation of monitoring wells to conduct soil/water sampling and testing at dumping station and soil sampling/ testing for lead contamination at firing ranges.

EPA FORM 2070-12: Attached.

POC: Mr. Constancio J. Labeste, (212) 264-6070/71.

Encl 3

PROJECT SUMMARY SHEET
FOR
DERP-FUDS OEW PROJECT No. C02NJ095102
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951
8 July 1993

PROJECT DESCRIPTION: The project consists of the following former areas and structures locations: two (2) former firing ranges areas, eleven (11) formerly used ammunition bunkers and surrounding beaches (for location see site map Encl 1).

PROJECT ELIGIBILITY: All of the above are the result of Navy activity at the site and are, therefore, eligible for cleanup under the DERP-FUDS program.

POLICY CONSIDERATIONS: There is no policy which prohibits the proposal of this project. The project consisting of areas and buildings or structures listed above on the project description are eligible for DERP-FUDS if it poses a safety hazard.

PROPOSED PROJECT: The proposed project requires further investigation on the site by CEHND to evaluate possible presence of ordnance explosive waste (OEW). U.S. Coast Guard reports OEW presence at former firing ranges and evidence findings of ordnance offshore by a local fisherman in 1970.

POC: Mr. Constancio J. Labeste, (212) 264-6070/71.

Encl 4

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POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION
01 STATE: NJ | 02 SITE NUMBER: C02NJ0951

II. SITE NAME AND LOCATION

01 SITE NAME: FORMER NAVAL AIR STATION - CAPE MAY
02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: BETWE PENNSYLVANIA and YALE AVENUE
03 CITY: CAPE MAY
04 STATE: NJ
05 ZIP CODE: 08204
06 COUNTY: CAPE MAY
07 COUNTY CODE:
08 CONG DIST:
09 COORDINATES: LATITUDE 39°15'00.0" LONGITUDE 075°15'00.0"
10 DIRECTIONS TO SITE: GARDEN STATE PARKWAY GOING SOUTH TO CAPE MAY, AFTER THE SECOND BRIDGE LOOK FOR SIGN TO U.S. COAST GUARD ALONG YALE AVE LOOK FOR PENNSYLVANIA AVE.. RIGHT TURN UNTIL YOU REACH THE GATE.

III. RESPONSIBLE PARTIES DOD

01 OWNER:
02 STREET:
03 CITY:
04 STATE:
05 ZIP CODE:
06 TELEPHONE NUMBER: ( )
07 OPERATOR:
08 STREET:
09 CITY:
10 STATE:
11 ZIP CODE:
12 TELEPHONE NUMBER: ( )

13 TYPE OF OWNERSHIP:
☐ A. PRIVATE ☒ B. FEDERAL: ______ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL
☐ F. OTHER: ______ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE:
☐ A. RCRA 3001 DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION: ☐ YES ☐ NO DATE: 6 25 93 (MONTH DAY YEAR)
BY: ☐ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR ☐ E. LOCAL HEALTH OFFICIAL ☒ F. OTHER: U.S. ARMY CORPS OF ENGRS NYD (Specify)
CONTRACTOR NAME(S):

02 SITE STATUS: ☒ A. ACTIVE ☐ B. INACTIVE ☐ C. UNKNOWN
03 YEARS OF OPERATION: ______ BEGINNING YEAR ______ ENDING YEAR ☒ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED:
POSSIBLE LEAD and OTHERS ARE UNKNOWN SUBSTANCES

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION:
POSSIBLE LEAD CONTAMINATION OF SOIL and OTHER UNKNOWN CONTAMINANTS

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
☐ A. HIGH (Inspection required promptly) ☒ B. MEDIUM (Inspection required) ☐ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT: COMMANDER GEOFFREY ABBOTT
02 OF (Agency/Organization): U.S. COAST GUARD
03 TELEPHONE NUMBER: (609) 898-6945
04 PERSON RESPONSIBLE FOR ASSESSMENT: C. LABESTE
05 AGENCY: COE
06 ORGANIZATION: CENAN-EN-IR
07 TELEPHONE NUMBER: (212) 264-6070
08 DATE: 7 12 93 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

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Encl 5

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POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
NJ	C02NJ0951

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- A SOLID
- B POWDER, FINES
- C SLUDGE
- X D OTHER METAL (Specify)
- E SLURRY
- F LIQUID
- G GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

- TONS UNKNOWN
- CUBIC YARDS UNKNOWN
- NO. OF DRUMS UNKNOWN

03 WASTE CHARACTERISTICS (Check all that apply)

- X A TOXIC
- B CORROSIVE
- C RADIOACTIVE
- D PERSISTENT
- E SOLUBLE
- F INFECTIOUS
- G FLAMMABLE
- H IGNITABLE
- I HIGHLY VOLATILE
- J EXPLOSIVE
- K REACTIVE
- L INCOMPATIBLE
- M NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE			
OLW	OILY WASTE			
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS	UNKNOWN	UNKNOWN	NONE NOTED

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
MES	LEAD	NONE	NONE	UNKNOWN	UNKNOWN

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS	NONE NOTED	NONE	FDS	NONE NOTED	NONE
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

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POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
NJ	C02NJ0951

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A. GROUNDWATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

POSSIBLE GROUND WATER CONTAMINATION

01 ☐ B. SURFACE WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ C. CONTAMINATION OF AIR
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ E. DIRECT CONTACT
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☒ F. CONTAMINATION OF SOIL
03 AREA POTENTIALLY AFFECTED ______ (Acres)
02 ☐ OBSERVED (DATE ______) ☒ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

POSSIBLE CONTAMINATION FROM LEAD and OTHER CONTAMINANTS

01 ☐ G. DRINKING WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ H. WORKER EXPOSURE/INJURY
03 WORKERS POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ I. POPULATION EXPOSURE/INJURY
03 POPULATION POTENTIALLY AFFECTED ______
02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

EPA FORM 2070-12 (7-81)

DRAFT

DRAFT

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION
01 STATE: NJ
02 SITE NUMBER: C02NJ0951

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION (include name(s) of species)

NONE NOTED

01 ☐ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES (Spills/runoff/standing liquids/leaking drums) — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED ________
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

NONE NOTED

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

POSSIBLE LEAD CONTAMINATION @ FORMER FIRING RANGES and OTHER ~~SOIL~~ UNKNOWN CONTAMINANTS FROM THE DUMPING AREA.

III. TOTAL POPULATION POTENTIALLY AFFECTED: UNKNOWN

IV. COMMENTS

NONE

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

FROM PRELIMINARY INVESTIGATION @ THE SITE

EPA FORM 2070-12 (7-81)

DRAFT

RISK ASSESSMENT PROCEDURES FOR
ORDNANCE AND EXPLOSIVE WASTE (OEW) SITES

Site Name	NAVAL AIR STATION - CAPE MAY	Rater's Name	C. LABESTE
Site Location	CAPE MAY, NEW JERSEY	Phone No.	(212) 264-6070
DERP Project #	C02NJ095103	Organization	CENAN-EN-IR
Date Completed	7/12/93	RAC Score	3

OEW RISK ASSESSMENT:

This risk assessment procedure was developed in accordance with MIL-STD 882B and AR 385-10. The RAC score will be used by CEHND to prioritize the remedial action at this site. The OEW risk assessment should be based upon best available information resulting from records searches, reports of Explosive Ordnance Disposal (EOD) detachment actions, and field observations, interviews, and measurements. This information is used to assess the risk involved based upon the potential OEW hazards identified at the site. The risk assessment is composed of two factors, **hazard severity and hazard probability**. Personnel involved in visits to potential OEW sites should view the CEHND videotape entitled "A Life Threatening Encounter: OEW."

Part I. Hazard Severity. Hazard severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel exposure to various types and quantities of unexploded ordnance items.

TYPE OF ORDNANCE
(Circle all values that apply)

A. Conventional Ordnance and Ammunition

	VALUE
Medium/Large Caliber (20 mm and larger)	10
Bombs, Explosive	10
Grenades, Hand and Rifle, Explosive	10
Landmines, Explosive	10
Rockets, Guided Missiles, Explosive	10
Detonators, Blasting Caps, Fuzes, Boosters, Bursters	6
Bombs, Practice (w/spotting charges)	6
Grenades, Practice (w/spotting charges)	4
Landmines, Practice (w/spotting charges)	4
Small Arms (.22 cal - .50 cal)	1
Conventional Ordnance and Ammunition (Select the largest single value)	10

What evidence do you have regarding conventional OEW? NAVAL AIR STATION @ CAPE MAY WAS USED AS SUBMARINE BASE & POSSIBLE USE OF TORPEDOES.

Encl 6

B. Pyrotechnics (For munitions not described above.)

	VALUE
Munition (Container) Containing White Phosphorus or other Pyrophoric Material (i.e., Spontaneously Flammable)	10
Munition Containing A Flame or Incendiary Material (i.e., Napalm, Triethlaluminum Metal Incendiaries)	6
Flares, Signals, Simulators	4

Pyrotechnics (Select the largest single value) 0

What evidence do you have regarding pyrotechnics? NONE

C. Bulk High Explosives (Not an integral part of conventional ordnance; uncontainerized.)

	VALUE
Primary or Initiating Explosives (Lead Styphnate, Lead Azide, Nitroglycerin, Mercury Azide, Mercury Fulminate, Tetracene, etc.)	10
Demolition Charges	10
Secondary Explosives (PETN, Compositions A, B, C, Tetryl, TNT, RDX, HMX, HBX, Black Powder, etc.)	8
Military Dynamite	6
Less Sensitive Explosives (Ammonium Nitrate, Explosive D, etc.)	3

High Explosives (Select the largest single value) 0

What evidence do you have regarding bulk explosives? NONE

D. Bulk Propellants (Not an integral part of rockets, guided missiles, or other conventional ordnance; uncontainerized)

	VALUE
Solid or Liquid Propellants	6

Propellants 0

What evidence do you have regarding bulk propellants? NONE

E. Radiological/Chemical Agent/Weapons

	VALUE
Toxic Chemical Agents (Choking, Nerve, Blood, Blister)	25
War Gas Identification Sets	20
Radiological	15
Riot Control and Miscellaneous (Vomiting, Tear, incendiary and smoke)	5

Radiological/Chemical Agent (Select the largest single value) 0

What evidence do you have of chemical/radiological OEW? NONE

Total Hazard Severity Value 10
(Sum of Largest Values for A through E--Maximum of 61).
Apply this value to Table 1 to determine Hazard Severity Category.

TABLE 1

HAZARD SEVERITY*

Description	Category	Value
CATASTROPHIC	I	≥21
CRITICAL	II	≥10 <21
MARGINAL	III	≥5 <10
NEGLIGIBLE	IV	≥1 <5
**NONE		0

*** Apply Hazard Severity Category to Table 3.**

**If Hazard Severity Value is 0, you do not need to complete Part II. Proceed to Part III and use a RAC Score of 5 to determine your appropriate action.

Part II. <u>Hazard Probability</u>. The probability that a hazard has been or will be created due to the presence and other rated factors of unexploded ordnance or explosive materials on a formerly used DOD site.

AREA, EXTENT, ACCESSIBILITY OF OEW HAZARD
(Circle all values that apply)

A. Locations of OEW Hazards

	VALUE
On the surface	5
Within Tanks, Pipes, Vessels or Other confined locations.	4
Inside walls, ceilings, or other parts of Buildings or Structures.	3
Subsurface	2

Location (Select the single largest value) 2

What evidence do you have regarding location of OEW? PRESENCE OF FORMERLY USE BUNKERS and FIRING RANGES

B. Distance to nearest inhabited locations or structures likely to be at risk from OEW hazard (roads, parks, playgrounds, and buildings).

	VALUE
Less than 1250 feet	5
1250 feet to 0.5 miles	4
0.5 miles to 1.0 mile	3
1.0 mile to 2.0 miles	2
Over 2 miles	1

Distance (Select the single largest value) 4

What are the nearest inhabited structures? APPLIED TRAINING FACILITY

C. Numbers of buildings within a 2 mile radius measured from the OEW hazard area, not the installation boundary.

	VALUE
26 and over	5
16 to 25	4
11 to 15	3
6 to 10	2
1 to 5	1
0	0

Number of Buildings (Select the single largest value) 5

Narrative SEVERAL BUILDINGS WITHIN 2 MILE RADIUS

D. Types of Buildings (within a 2 mile radius)

	VALUE
Educational, Child Care, Residential, Hospitals, Hotels, Commercial, Shopping Centers	5
Industrial, Warehouse, etc.	4
Agricultural, Forestry, etc.	3
Detention, Correctional	2
No Buildings	0

Types of Buildings (Select the largest single value) 5

Describe types of buildings in the area. ADMINISTRATION, TRAINING SCHOOL, EXCHANGE and WAREHOUSES OR STORAGES.

E. Accessibility to site refers to access by humans to ordnance and explosive wastes. Use the following guidance:

BARRIER	VALUE
No barrier or security system	5
Barrier is incomplete (e.g., in disrepair or does not completely surround the site). Barrier is intended to deny egress from the site, as for a barbed wire fence for grazing.	4
A barrier, (any kind of fence in good repair) but no separate means to control entry. Barrier is intended to deny access to the site.	3
Security guard, but no barrier	2
Isolated site	1
A 24-hour surveillance system (e.g., television monitoring or surveillance by guards or facility personnel) which continuously monitors and controls entry onto the facility; or An artificial or natural barrier (e.g., a fence combined with a cliff), which completely surrounds the facility; and a means to control entry, at all times, through the gates or other entrances to the facility (e.g., an attendant, television monitors, locked entrances, or controlled roadway access to the facility).	0

Accessibility (Select the single largest value) 3

Describe the site accessibility. ACCESSABLE BY CAR THRU SECURITY GATE GUARD and ACCESS THRU THE BEACHES.

F. Site Dynamics - This deals with site conditions that are subject to change in the future, but may be stable at the present. Examples would be excessive soil erosion by beaches or streams, increasing land development that could reduce distances from the site to inhabitated areas or otherwise increase accessability.

	VALUE
Expected	5
None Anticipated	0

Site Dynamics (Select largest value) 5

Describe the site dynamics. SITE and ITS PRESENT BEACHES WILL LOST ACREAGE THRU BEACHES EROSION.

Total Hazard Probability Value
(Sum of Largest Values for A through F--Maximum of 30) **24**

Apply this value to Hazard Probability Table 2 to determine Hazard Probability Level.

TABLE 2

HAZARD PROBABILITY

Description	Level	Value
FREQUENT	A	≥ 27
PROBABLE	B	≥ 21 <27
OCCASIONAL	C	≥ 15 <21
REMOTE	D	≥ 8 <15
IMPROBABLE	E	<8

*** Apply Hazard Probability Level to Table 3.**

Part III. Risk Assessment. The risk assessment value for this site is determined using the following Table 3. Enter with the results of the hazard probability and hazard severity values.

TABLE 3

Probability Level		FREQUENT A	PROBABLE B	OCCASIONAL C	REMOTE D	IMPROBABLE E
Severity Category:						
CATASTROPHIC	I	1	1	2	3	4
CRITICAL	II	1	2	3	4	5
MARGINAL	III	2	3	4	4	5
NEGLIGIBLE	IV	3	4	4	5	5

RISK ASSESSMENT CODE (RAC)

RAC 1 Imminent Hazard - Expedite INPR - Immediately call CEHND-ED-SY-- commercial 205-955-4968 or DSN 645-4968.

RAC 2 High priority on completion of INPR - Recommend further action by CEHND.

RAC 3 Complete INPR - Recommend further action by CEHND.

RAC 4 Complete INPR - Recommend further action by CEHND.

RAC 5 Recommend no further action. Submit NOFA and RAC to CEHND.

Part IV. Narrative. Summarize the documented evidence that supports this risk assessment. If no documented evidence was available, explain all the assumptions that you made.

THE ASSUMPTION WERE MADE THROUGH THE PRESENCE OF FORMERLY USED AMMUNITION BUNKERS and FIRING RANGES. ANOTHER ASSUMPTION WAS BASE ON THE UTILIZATION OF NAVAL STATION AS SUBMARINE BASE and AIRFIELD

SITE SURVEY SUMMARY SHEET (Revised)
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
19 September 1994

SITE NAME: Naval Air Station - Cape May

LOCATION: Cape May, New Jersey

SITE HISTORY: The site is located in the City of Cape May, Cape May County, New Jersey. As per deed dated 2 December 1918 and Declarations of Taking dated 16 July 1941 and 24 June 1942, the Government did obtain 426.774 acres fee. From 1916 to 1946, the Navy ultilized the site as a training facility, airport and submarine base. On 1 June 1946, the Secretary of the Navy conveyed 426.774 acres fee to the United States Coast Guard. Since 1946, approximately 101.814 acres has been lost to erosion and other forces of nature. At the present time the United States Coast Guard is still the owner of record of the site.

SITE VISIT: A site visit was conducted on 25 June 1993. Mr. Constancio J. Labeste and Honesto Castaneda of CENAN-EN-IR visited the site in Cape May, New Jersey. Our point of contact is Commander Geoffrey L. Abbott, Commanding Officer U.S. Coast Guard Training Center, Cape May, New Jersey 08204 [(609) 898-6945]. In the course of our investigation with John Herr, Chief Design Section we found the following: fourteen (14) formerly used buildings or structures (beneficially used by the current owner) out of one hundred five (105) erected at the site, locations of the two former firing ranges area, one former abandoned dumping site and locations of eleven (11) formerly used ammunition bunkers (beneficially used by the current owner). A total of thirteen (13) different sizes underground fuel storage tanks were removed and disposed in accordance with the New Jersey State Department of Environmental Protection and Energy (NJSDEPE) requirements by the U.S. Coast Guard, including installation of monitoring wells. All the tanks were beneficially used by the Coast Guard before the removal. Base on our findings at the site we only recommend further investigation on the following items: one abandoned dumping station, two firing ranges, formerly used ammunition bunkers and surrounding beaches for possible evidence of hazardous/toxic waste and ordnance at the site. Therefore; we are proposing the HTRW and OEW project at this site.

CATEGORY OF HAZARD: HTRW and OEW

PROJECT DESCRIPTION: There are two (2) potential projects at this site.

SITE SURVEY SUMMARY SHEET (Revised)
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
19 September 1994

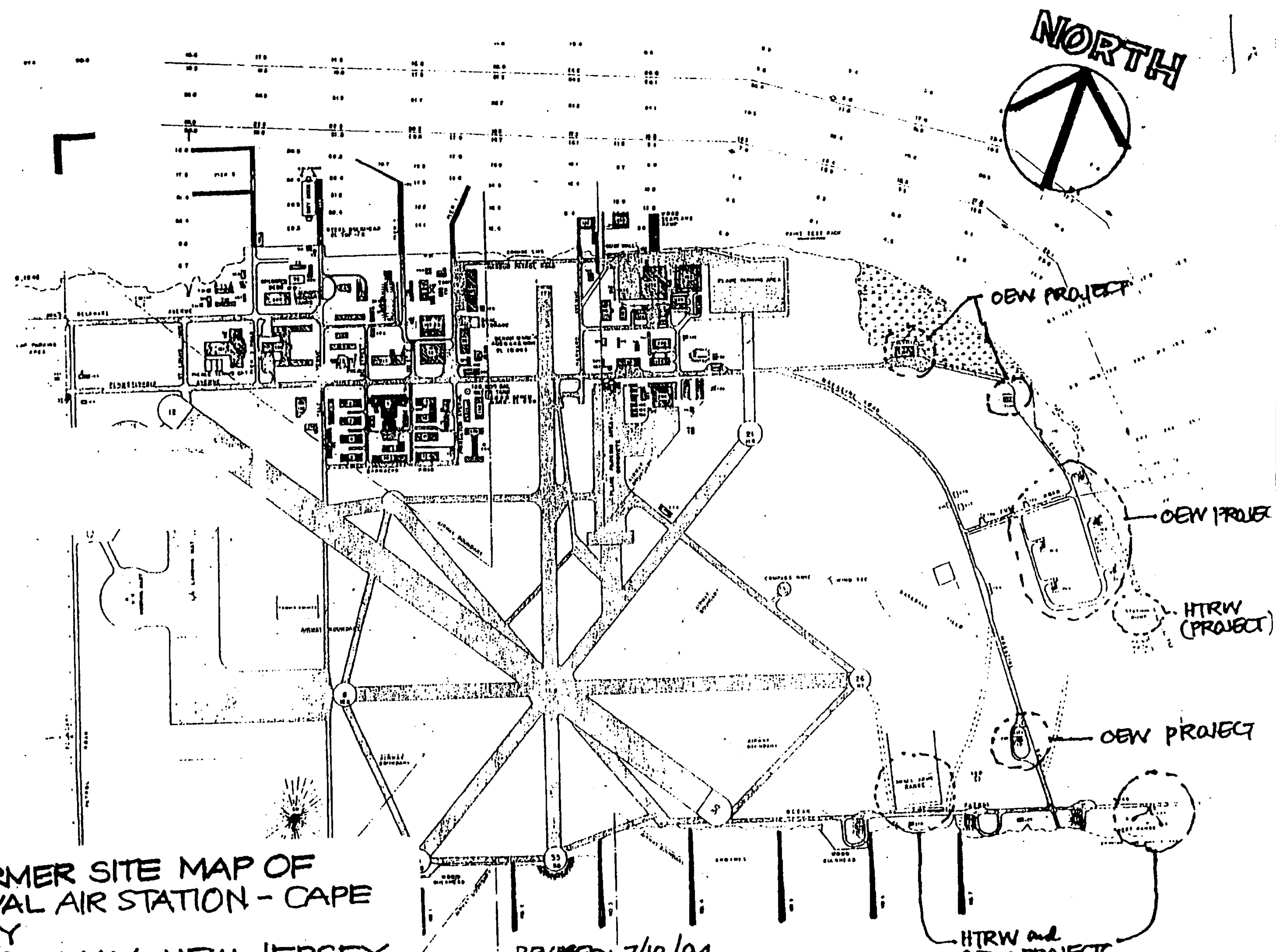
(continuation)

a. HTRW. Location of one abandoned dumping station and two firing ranges (for location see site map on Encl 1).

b. OEW. Locations of eleven (11) formerly used ammunition bunkers, two former firing ranges and surrounding beaches (for location see site map on Encl 1). Evidence findings of small caliber bullets at the former firing ranges and ordnance offshore by a local fisherman in 1970.

AVAILABLE STUDIES: Dames and Moore final report " Hazardous Materials Survey " of soil and groundwater investigation conducted in the area of formerly used Building No. 190 was submitted for reference only.

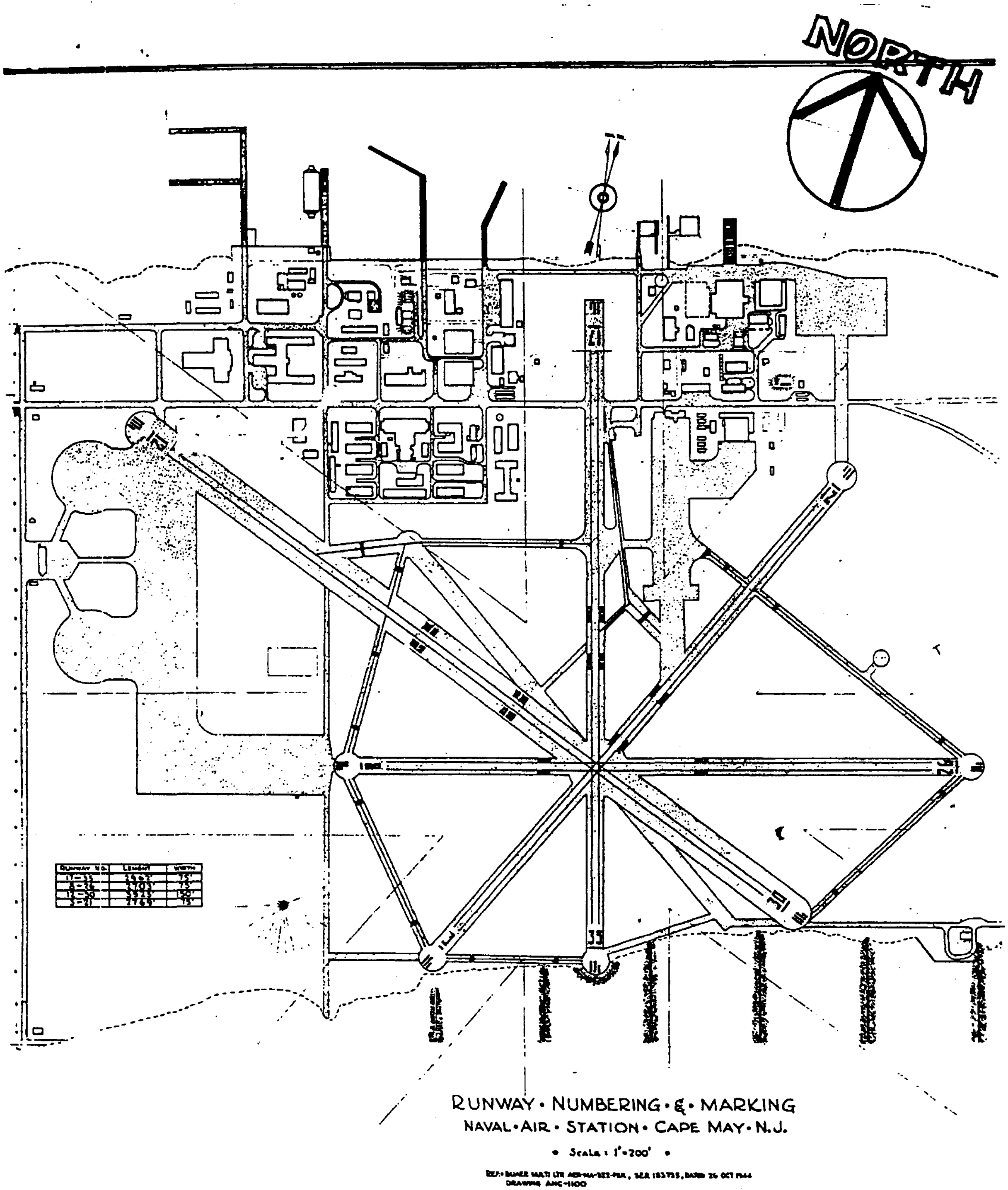
PA POC: Mr. Constancio J. Labeste, (212) 264-6070/71 is the New York District POC.



FORMER SITE MAP OF
NAVAL AIR STATION - CAPE
MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951

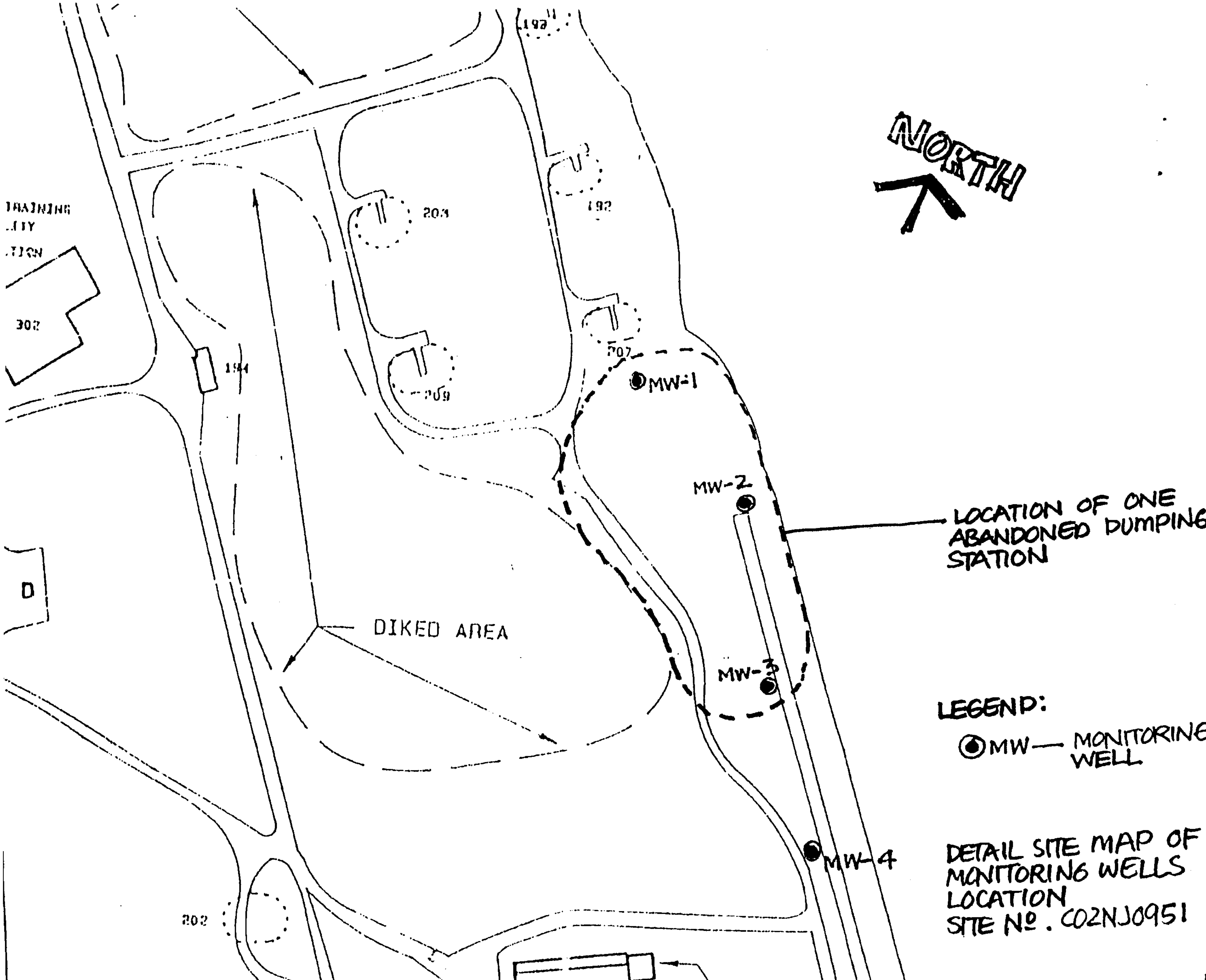
REVISED: 7/18/94

Encl 1



FORMER SITE MAP OF
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951
REVISED: 7/18/94

Encl



DETAIL SITE MAP OF MONITORING WELLS LOCATION
SITE No. C02NJ0951

Encl 1

PROJECT SUMMARY SHEET (Revised)
FOR
DERP-FUDS HTRW PROJECT No. C02NJ095101
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
SITE No. C02NJ0951
8 May 1995

PROJECT DESCRIPTION: The project consists of the following former area locations: two abandoned firing ranges areas and one abandoned dumping station (for location see site map Encl 1). Dumping station shown on old station map, no available studies.

PROJECT ELIGIBILITY: The abandoned dumping station including the two abandoned firing ranges are utilized by the Navy in the past and are, therefore, eligible for cleanup under the DERP-FUDS program.

POLICY CONSIDERATIONS: There is no policy which prohibits the proposal of this project. The project consisting of areas listed above on project description are eligible for DERP-FUDS if it poses a health hazard.

PROPOSED ACTIVITIES: The proposed project consists of installation of monitoring wells to conduct soil/water sampling and soil gas survey at the dumping station. Soil sampling/ testing (hand-dug) for lead contamination at two firing ranges. No HTRW activity will be initiated at this site until CEHND has reviewed the OEW project and has determined that the potential OEW contamination at the site does not constitute an imminent safety hazard.

COST ESTIMATE: Attached.

EPA FORM 2070-12: Attached.

POC: Mr. Constancio J. Labeste, (212) 264-6070/71 is the New York District POC.

BACK-UP COST ESTIMATE (Revised)
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
8 May 1995

HTRW:

A. Field Investigation:

Dumping Station:

1. Soil gas survey - estimate two - 1 acre grid @ $ 1,799.00 each
   2 x 1,799 $ 3,598.00

2. Soil augering and monitoring wells at 4 locations @ $ 4,000.00 each
   4 x 4,000 $ 16,000.00

3. Soil sampling analysis at 4 locations (3 samples/location) @ $ 2,714.00 each
   12 x 2,714 $ 35,568.00

4. Water sampling and analysis as per (NJSDEPE, regulation), for Benzene, Toluene, Xylene, ethylbenzene and lead
   First round ground water sampling analysis at 4 location (4 per location).
   a. BTEX analysis @ $ 160.00 each
      16 x 160 $ 2,560.00
   b. B/N/A extractables @ $ 728.00 each
      16 x 728 $ 11,648.00
   c. 8 metals analysis @ $ 208.00 each
      16 x 208 $ 3,328.00
   d. TPHC analysis @ $ 104.00 each
      16 x 104 $ 1,664.00

   Second round ground water sampling analysis at 4 location (4 per location).
   a. BTEX analysis @ $ 160.00 each
      16 x 160 $ 2,560.00
   b. B/N/A extractables @ $ 728.00 each
      16 x 728 $ 11,648.00
   c. 8 metals analysis @ $ 208.00 each
      16 x 208 $ 3,328.00
   d. TPHC analysis @ $ 104.00 each
      16 x 104 $ 1,664.00

5. Geophysical surveys, sampling, shallow hand-dug pits testing including soil screening at two (2) abandoned firing ranges for lead contamination (lump sum)
   $ 20,000.00

Encl 7

BACK-UP COST ESTIMATE (Revised)
FOR
DERP-FUDS SITE No. C02NJ0951
NAVAL AIR STATION - CAPE MAY
CAPE MAY, NEW JERSEY
8 May 1995

(continuation)

	Total	$ 113,566.00
6.	Field Labor, Mobilization/Demobolization @ 10% total field investigation.	$ 11,357.00
	Total Field Investigation	$ 124,923.00
B.	<u>Report and work plan preparation (50%):</u> Health and Safety Plan, Chemical Data Acquisition Plan, Quality Control Plan, Analysis of Samples and recommendations/alternative report.	$ 62,462.00
	Total A and B	$ 187,385.00
C.	Government Supervision and Administration (20%)	$ 37,477.00
	Grand Total	$ 224,862.00
D.	Contingencies @ (10%)	22,486.00
	Total Implementation Cost	$ 247,348.00

1. COMPONENTS	FY 1993 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8 May 1995

3. INSTALLATION AND LOCATION NAVAL AIR STATION - CAPE MAY CAPE MAY, NEW JERSEY (Revised)	4. PROJECT TITLE DERP-FUDS

5. PROGRAM ELEMENT	6. CATEGORY CODE HTRW	7. PROJECT NUMBER C02NJ095101	8. PROJECT COST ($000) 246

9. COST ESTIMATES

ITEM SITE INVESTIGATION	UM	QUANTITY	UNIT COST	COST (000)
INVESTIGATION COSTS (SEE BACKUP)				125
REPORT AND WORK PLAN PREPARATION (50%)				62.5
SUBTOTAL				187
SUPERVISION AND ADMINISTRATION (20%)				37
CONTINGENCIES (10%)				22
Note: Escalation costs will be added prior to the execution of the project.				
TOTAL IMPLEMENTATION COST				246

10. DESCRIPTION OF PROPOSED WORK
10.1 Soil gas surveys: estimate two - 1 acre grids (at dumping area)
10.2 Soil boring and monitoring wells at four (4) locations (at dumping site).
10.3 Soil sampling and analysis as per (NJDEPE State regulation).
10.4 Water sampling and analysis as per (NJDEPE State regulation).
10.5 Geophysical surveys, sampling, shallow hand-dug pits testing including soil screening at two (2) firing ranges for possible lead contamination.

Encl 6

APPENDIX C

Figures, Tables, and Boring Logs from Ogden (1998)

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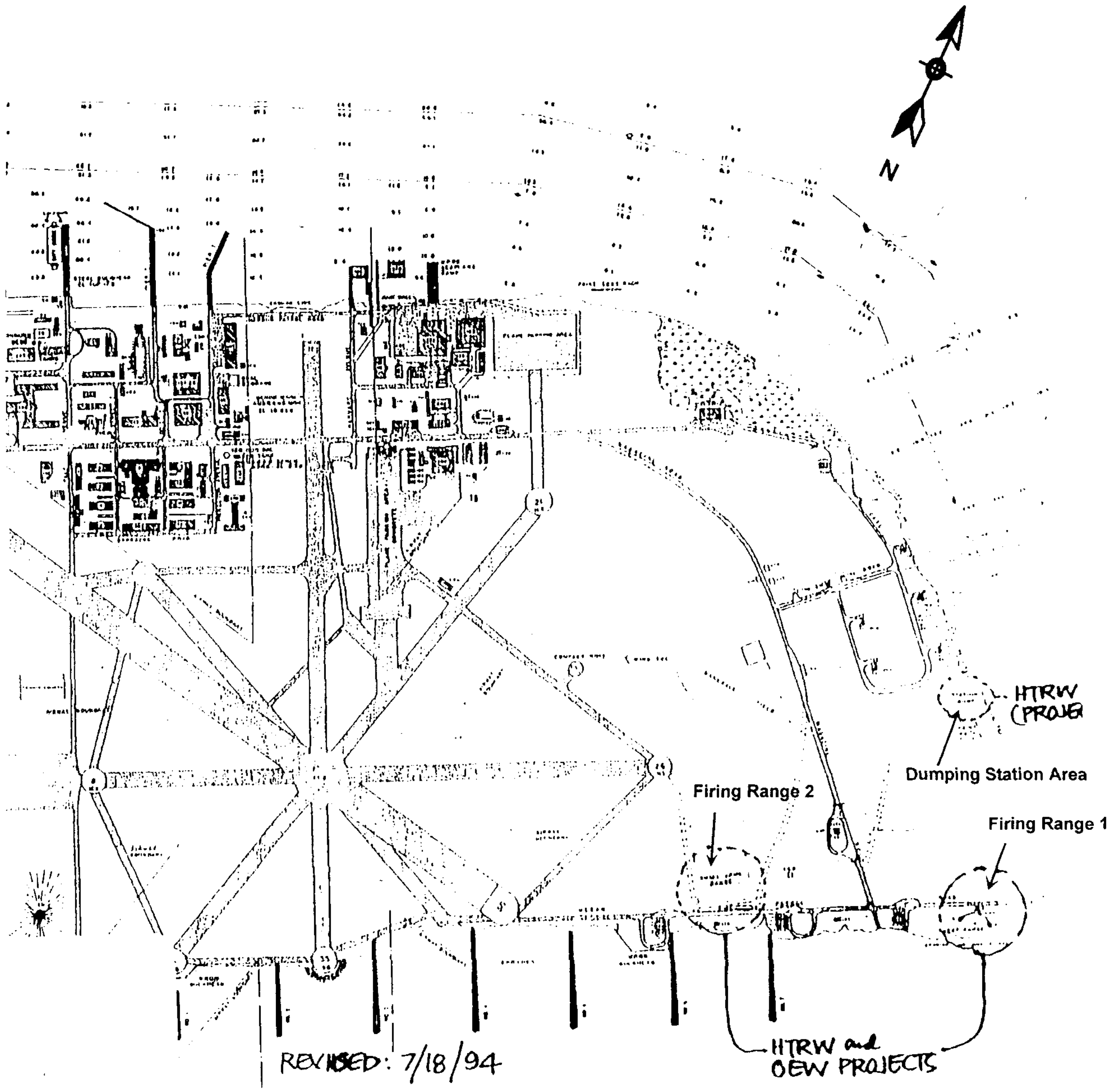


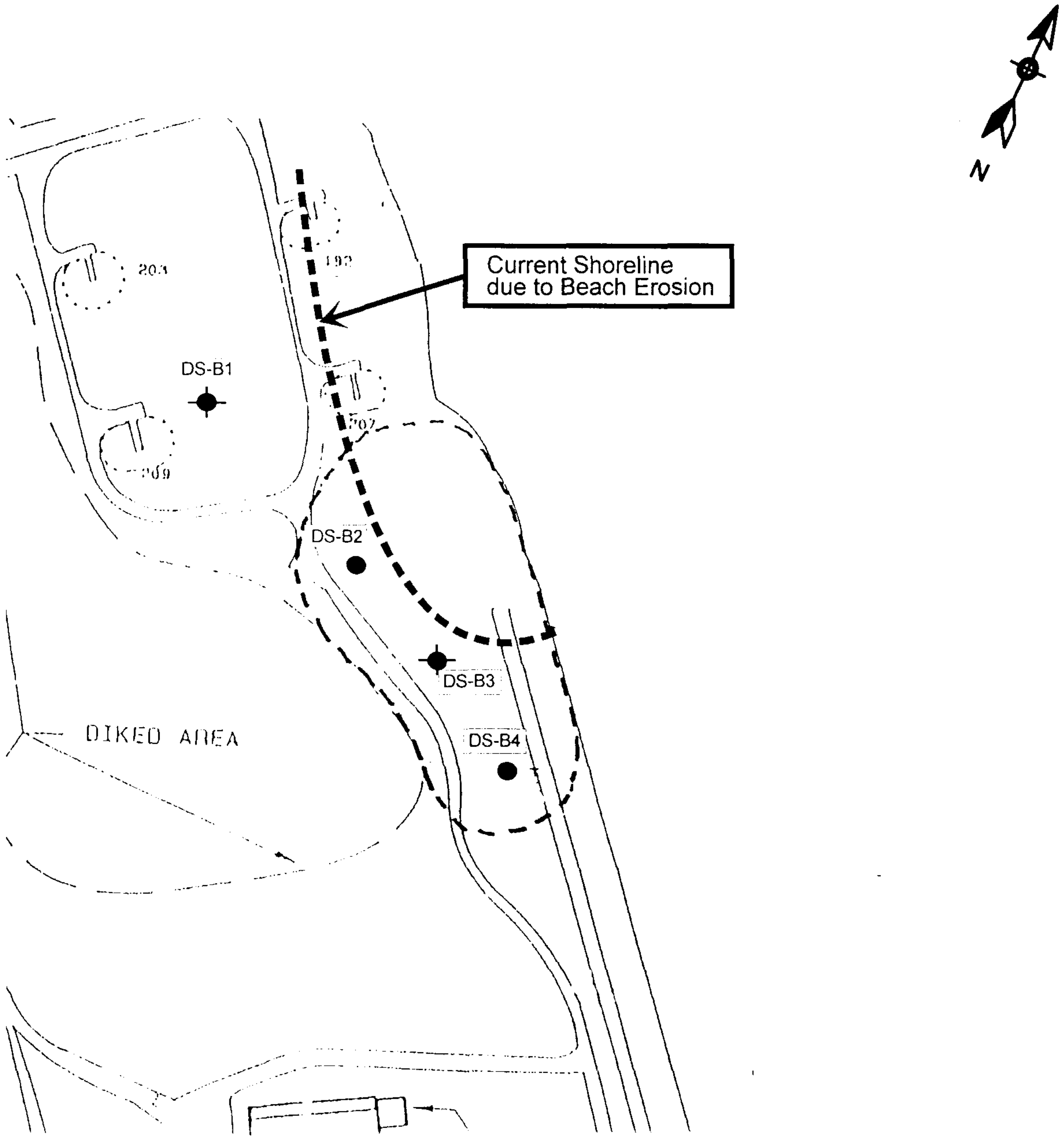
Not to Scale

Source: Encl. 1 DERP-FUDS Inventory Project Report (INPR) For Site No. C02NJ0951, NAS Cape May, NJ
31 May 1995

Figure 2-2
Dumping Station Area/Firing Range Areas
Naval Air Station, Cape May, New Jersey

U.S. Army Corps of Engineers, New York District
DACW51-97-D-0010; Work Order No. 0008

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC.
285 DAVIDSON AVENUE, SOMERSET, NEW JERSEY 08873



Not to Scale

DS-B1 Approximate Boring Location and Designation

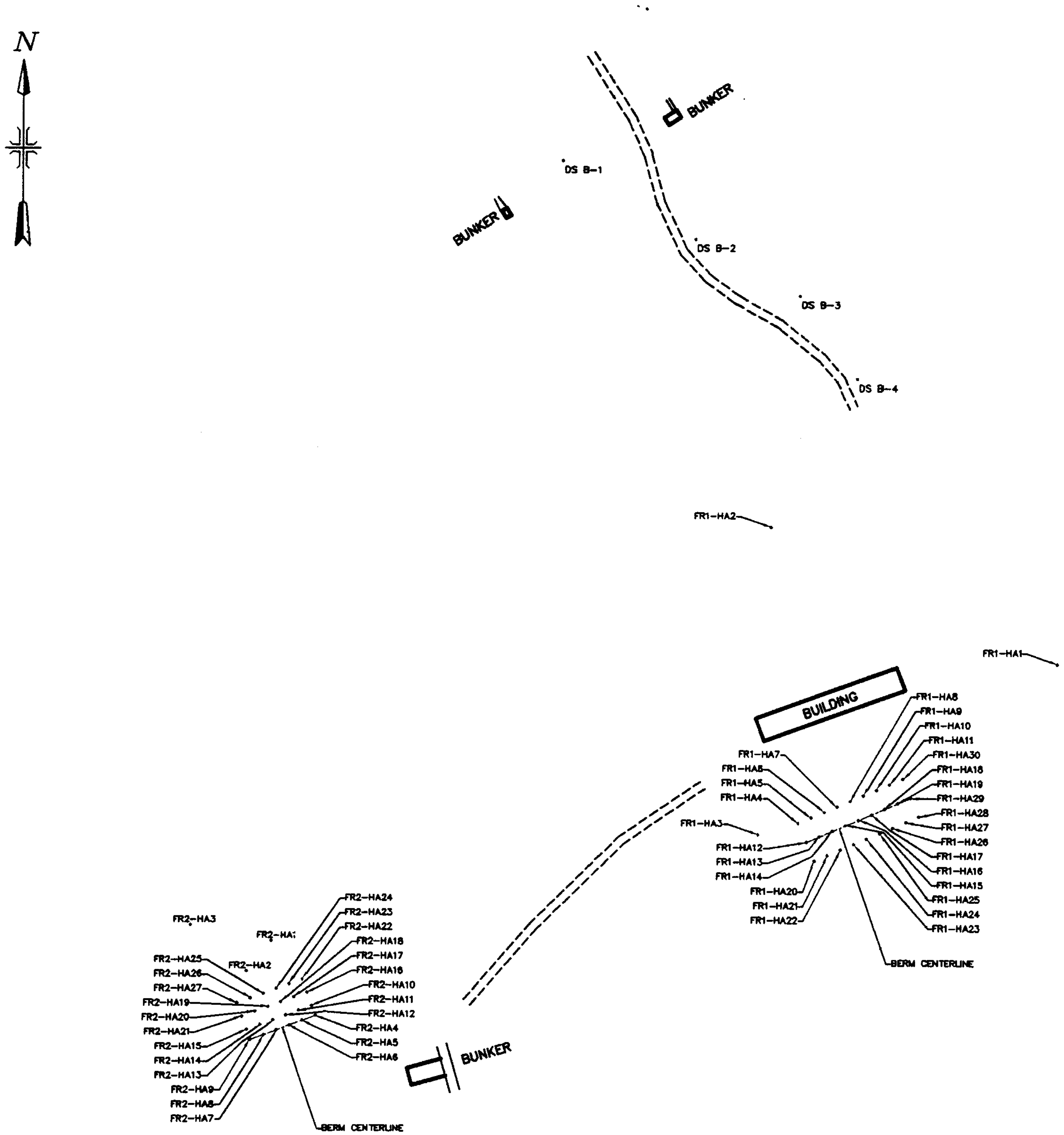
Indicates Ground Water Sample Recovery at Boring Location

Basemap Source: Encl. 1 DERP-FUDS Inventory Project Report (INPR) For Site No. C02NJ0951, NAS, Cape May, NJ
31 May 1995

Figure 3-1
Work Plan
Proposed Boring Locations, Dumping Station Area
Naval Air Station, Cape May, New Jersey

U.S. Army Corps of Engineers, New York District
DACW51-97-D-0010; Work Order No. 0008

OGDEN ENVIRONMENTAL AND ENERGY SERVICES CO., INC.
285 DAVIDSON AVENUE, SOMERSET, NEW JERSEY 08873



DESCRIPTION	NORTHING	EASTING
FR2-HA1	385100.927321	40408.009464
FR2-HA2	385065.665038	40364.722979
FR2-HA3	384987.015390	40430.005495
FR2-HA4	385165.293033	40302.132577
FR2-HA5	385146.522601	40295.228167
FR2-HA6	385127.752169	40288.323757
FR2-HA7	385108.981737	40281.419346
FR2-HA8	385090.211305	40274.514936
FR2-HA9	385071.440873	40267.610526
FR2-HA10	385160.114726	40316.210401
FR2-HA11	385141.344294	40309.305991
FR2-HA12	385122.573862	40302.401581
FR2-HA13	385103.803430	40295.497170
FR2-HA14	385085.032998	40288.592760
FR2-HA15	385066.262566	40281.688350
FR2-HA16	385153.210315	40334.980833
FR2-HA17	385134.439883	40328.076423
FR2-HA18	385115.669451	40321.172013
FR2-HA19	385096.899019	40314.267602
FR2-HA20	385078.128587	40307.363192
FR2-HA21	385059.358155	40300.458782
FR2-HA22	385146.305905	40353.751265
FR2-HA23	385127.535473	40346.846855
FR2-HA24	385108.765041	40339.942445
FR2-HA25	385089.994609	40333.038034
FR2-HA26	385071.224177	40326.133624
FR2-HA27	385052.453745	40319.229214

DESCRIPTION	NORTHING	EASTING
FR1-HA1	386214.579003	40803.687069
FR1-HA2	385809.499360	40995.299121
FR1-HA3	385792.382037	40580.143901
FR1-HA4	385849.699425	40576.893372
FR1-HA5	385868.059889	40584.623907
FR1-HA6	385886.420352	40592.554441
FR1-HA7	385904.780816	40600.484975
FR1-HA8	385923.141280	40608.415510
FR1-HA9	385941.501743	40616.346044
FR1-HA10	385959.862207	40624.276578
FR1-HA11	385978.222671	40632.207113
FR1-HA12	385861.198700	40550.070700
FR1-HA13	385879.559164	40558.001234
FR1-HA14	385897.919627	40565.931769
FR1-HA15	385916.280091	40573.862303
FR1-HA16	385934.640555	40581.792837
FR1-HA17	385953.001018	40589.723372
FR1-HA18	385971.361482	40597.653906
FR1-HA19	385989.721945	40605.584441
FR1-HA20	385872.697975	40523.448028
FR1-HA21	385891.058438	40531.378562
FR1-HA22	385909.418902	40539.309096
FR1-HA23	385927.779366	40547.239631
FR1-HA24	385946.139829	40555.170165
FR1-HA25	385964.500293	40563.100700
FR1-HA26	385982.860757	40571.031234
FR1-HA27	386001.221220	40578.961768
FR1-HA28	386019.581684	40586.892303
FR1-HA29	386008.082409	40613.514975
FR1-HA30	385996.583134	40640.137647

NOTES

THIS DRAWING WAS PREPARED USING INFORMATION TAKEN FROM SURVEY DATA PREPARED BY:
JAMES M. STEWART, INC.
LAND SURVEYORS
9622 EVANS STREET
PHILADELPHIA, PA

GRAPHIC SCALE
0 100' 200' 300'
1" = 200'

PROJECT MANAGER: S. Posten | DRAWN BY: L&M Associates | DATE: 11/19/97

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

FIGURE 3-2
LOCATION PLAN
SOIL SAMPLES & BORINGS
UNITED STATES NAVAL AIR STATION
CAPE MAY, NEW JERSEY
NOVEMBER 1997
Prepared For:
U.S. ARMY CORPS OF ENGINEERS
NEW YORK DISTRICT
DACW51-97-D-0010; WORK ORDER No. 0008

PROJECT NO.	FILE NO.	CHK'D: / ENG. / APPVD.	DRAWING NUMBER	REV. NO.
7-7076-0008	(D)		77076-02	-

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TABLE 4-1
FIRING RANGE AREAS
SOIL LEAD ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation	Laboratory Number	Sample Depth (ft)	Lead (mg/kg) [a]	
FR1-HA1-01	26752	0.0-0.5	16.2	N
FR1-HA2-01	26753	0.0-0.5	19.6	N
FR1-HA3-01	26754	0.0-0.5	288	N
FR1-HA4-01	26755	0.0-0.5	**547**	N
FR1-HA5-01	26756	0.0-0.5	**428**	N
FR1-HA6-01	26757	0.0-0.5	**551**	N
FR1-HA7-01	26784	0.0-0.5	320	*
FR1-HA8-01	26786	0.0-0.5	**708**	*
FR1-HA8-01	26787	1.0-1.5	**2,410**	*
FR1-HA8-01	26788	2.0-2.5	**500**	*
FR1-HA9-01	26758	0.0-0.5	**920**	N
FR1-HA10-01	26789	0.0-0.5	**740**	*
FR1-HA11-01	26759	0.0-0.5	**552**	N
FR1-HA12-01	26776	0.0-0.5	**463**	*
FR1-HA12-02 [b]	26777	0.0-0.5	**1,760**	*
FR1-HA13-01	26760	0.0-0.5	286	N
FR1-HA13-01	26826	1.0-1.5	23.9	
FR1-HA13-01	26827	2.0-2.5	6.1	
FR1-HA14-01	26761	0.0-0.5	**9,230**	N
FR1-HA15-01	26762	0.0-0.5	80.6	N
FR1-HA16-01	26778	0.0-0.5	170	*
FR1-HA16-01	26779	1.0-1.5	**34,600**	*
FR1-HA16-01	26780	2.0-2.5	297	*
FR1-HA17-01	26763	0.0-0.5	90.5	N
FR1-HA18-01	26781	0.0-0.5	248	*
FR1-HA19-01	26764	0.0-0.5	**957**	N
FR1-HA20-01	26765	0.0-0.5	**446**	N
FR1-HA21-01	26771	0.0-0.5	342	N
FR1-HA22-01	26766	0.0-0.5	**4,120**	N
FR1-HA23-01	26767	0.0-0.5	**137,300**	N
FR1-HA24-01	26773	0.0-0.5	**882**	*
FR1-HA24-02 [b]	26774	0.0-0.5	**813**	*
FR1-HA25-01	26768	0.0-0.5	**3,460**	
FR1-HA26-01	26769	0.0-0.5	**7,880**	
FR1-HA27-01	26770	0.0-0.5	**6,730**	
FR1-HA28-01	26775	0.0-0.5	**1,130**	*
FR1-HA29-01	26783	0.0-0.5	301	*
FR1-HA30-01	26791	0.0-0.5	**945**	*

Sample Designation	Laboratory Number	Sample Depth (ft)	Lead (mg/kg) [a]	
FR2-HA1-01	26823	0.0-0.5	**511**	
FR2-HA2-01	26824	0.0-0.5	217	
FR2-HA3-01	26825	0.0-0.5	**2,170**	
FR2-HA4-01	26792	0.0-0.5	**877**	N*
FR2-HA5-01	26793	0.0-0.5	291	N*
FR2-HA6-01	26794	0.0-0.5	**852**	N*
FR2-HA7-01	26796	0.0-0.5	**2,070**	N*
FR2-HA7-01	26797	1.0-1.5	394	
FR2-HA7-01	26798	2.0-2.5	5.5	
FR2-HA8-01	26802	0.0-0.5	**2,320**	N*
FR2-HA9-01	26805	0.0-0.5	**2,590**	N*
FR2-HA10-01	26808	0.0-0.5	**505**	N*
FR2-HA11-01	26809	0.0-0.5	**1,990**	N*
FR2-HA12-01	26810	0.0-0.5	**634**	N*
FR2-HA13-01	26812	0.0-0.5	343	
FR2-HA13-01	26813	1.0-1.5	3.1	U
FR2-HA13-01	26814	2.0-2.5	4.5	B
FR2-HA14-01	26819	0.0-0.5	**670**	
FR2-HA15-01	26821	0.0-0.5	**821**	
FR2-HA16-01	26799	0.0-0.5	34.8	N*
FR2-HA17-01	26800	0.0-0.5	143	N*
FR2-HA17-02 [b]	26801	0.0-0.5	130	N*
FR2-HA18-01	26803	0.0-0.5	177	N*
FR2-HA19-01	26804	0.0-0.5	262	N*
FR2-HA20-01	26811	0.0-0.5	217	N*
FR2-HA21-01	26806	0.0-0.5	27.3	N*
FR2-HA21-02 [b]	26807	0.0-0.5	31.2	N*
FR2-HA22-01	26822	0.0-0.5	41.2	
FR2-HA22-01	26854	1.0-1.5	15.3	
FR2-HA22-01	26855	2.0-2.5	5.7	
FR2-HA23-01	26820	0.0-0.5	331	
FR2-HA24-01	26818	0.0-0.5	120	
FR2-HA25-01	26817	0.0-0.5	24.7	
FR2-HA26-01	26816	0.0-0.5	20.2	
FR2-HA27-01	26815	0.0-0.5	7.8	

FB-101597-1 [c]	26828	---	33.5 (mg/L)	U
FB-101597-2 [c]	26829	---	33.5 (mg/L)	U

All samples collected 10/15/97 except FR2-HA22 (1.5-2.0 ft and 2.5-3.0 ft samples), collected 10/16/97

DATA QUALIFIER:

* Duplicate analysis not within control limits

N: Spiked sample recovery not within control limits

B: Reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL)

U: Compound not detected at the indicated concentration

NOTES:

[a] ***Bold*** values exceed NJDEP Residential Direct Contact Soil Cleanup Criterion of 400 mg/kg

[b] Sample duplicate

[c] Field blank

TABLE 4-2
FIRING RANGE AREAS
GROUND WATER METALS ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP	FR1-B1-GW-01	FR1-B1-GW-01	FR2-B1-GW-01	FR2-B1-GW-01
Laboratory Number >	GWQS	26845	26852	26846	26853
Matrix >	---	Total	Dissolved	Total	Dissolved
Units >	ug/L	ug/L	ug/L	ug/L	ug/L
NOTES>	[a]	[b]	[b]	[b]	[b]
Aluminum	200	***89,600***N	74.6 UN	***35,000***N	77.5 BN
Antimony	20	17.8 B	6.3 B	5.3 U	5.3 U
Arsenic	8	***88.1***	3.5 B	***32.4***	3.4 U
Barium	2,000	341 B	15.6 B	109	16.1 B
Beryllium	20	4.5	0.30 U	1.6 B	0.30 U
Cadmium	4	0.80 U	0.40 U	0.40 U	0.40 U
Calcium	NA	125,000	10,3000	55,700	41,200
Chromium	100	***538***	1.7 U	***245***	16.5
Cobalt	NA	69.7 B	1.3 U	21.5 B	8.5 B
Copper	1,000	353	4.0 U	120	4.0 U
Iron	300	***224,000***	***2,210***	***71,600***	***1,200***
Lead	10	***413***	2.2 U	***69.2***	2.2 U
Magnesium	NA	43,900	13,400	44,300	28,900
Manganese	50	***1,830***	***167***	***696***	***102***
Mercury	2	0.16 B	0.10 U	0.10 U	0.10 U
Nickel	100	***263***	7.5 B	***395***	***474***
Potassium	NA	23,300	9,700	26,000	19,000
Selenium	50	9.6 U	4.8 U	4.8 U	4.8 U
Silver	NA	2.4 U	1.2 U	1.2 U	1.2 U
Sodium	50,000	***65,800***	***54,200***	***282,000***	***256,000***
Thallium	10	7.6 U	3.8 U	3.8 U	3.8 U
Vanadium	NA	209	2.5 U	91.1	3.5 B
Zinc	5,000	1,210	44.9	303	8.9 B

All samples collected 10/16/97

QUALIFIERS:

N: Spiked sample recovery not within control limits

U: Compound not detected at the indicated concentration

B: Reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL)

NOTES:

[a] NJDEP Ground Water Quality Standards - Class II-A: NJAC 7:9-6; State Primary Drinking Water Standards: NJAC 7:10-5.1, 5.2

[b] ***Bold*** values exceed NJDEP GWQS

TABLE 4-3
DUMPING STATION AREA
SOIL VOLATILE ORGANIC COMPOUND ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP Criteria [a]			DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01	FB-101697	TB-101697
Laboratory Number >	RDC-SCC	NRDC-SCC	IGW-SCC	26830	26831	26833	26834	26835	26837	26838	26839	26847	26848	26856
Units >	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/l	ug/kg
NOTES >	[b]	[c]	[d]			[e]							[f]	[g]
1,1-Dichloroethane	570,000	1,000,000	10,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,1-Dichloroethene	8,000	150,000	10,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,1,1-Trichloroethane	210,000	1,000,000	50,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,1,2-Trichloroethane	22,000	420,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,1,2,2-Tetrachloroethane	34,000	70,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,2-Dichloroethane	6,000	24,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
1,2-Dichloropropane	10,000	43,000	NA	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
2-Butanone	1,000,000	1,000,000	50,000	660 U	640 U	640 U	640 U	640 U	590 U	650 U	620 U	750 U	5.0 U	620 U
2-Hexanone	NA	NA	NA	660 U	640 U	640 U	640 U	640 U	590 U	650 U	620 U	750 U	5.0 U	620 U
4-Methyl-2-Pentanone	1,000,000	1,000,000	50,000	660 U	640 U	640 U	640 U	640 U	590 U	650 U	620 U	750 U	5.0 U	620 U
Acetone	1,000,000	1,000,000	100,000	660 U	640 U	640 U	640 U	640 U	590 U	650 U	620 U	750 U	5.0 U	620 U
Benzene	3,000	13,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Bromodichloromethane	11,000	46,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Bromoform	86,000	370,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Bromomethane	79,000	1,000,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
CarbonDisulfide	NA	NA	NA	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
CarbonTetrachloride	2,000	4,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Chlorobenzene	37,000	680,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Chloroethane	NA	NA	NA	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Chloroform	19,000	28,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Chloromethane	520,000	1,000,000	10,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
cis-1,2-Dichloroethene	79,000	1,000,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
cis-1,3-Dichloropropene	4,000	5,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Dibromochloromethane	110,000	1,000,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Ethylbenzene	1,000,000	1,000,000	100,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
MethyleneChloride	49,000	210,000	1,000	220 B	360 B	230 B	240 B	140 B	150 B	140 B	140 B	200 B	1.0 U	160 B
Styrene	23,000	97,000	100,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Tetrachloroethene	4,000	6,000	1,000	130 U	130	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Toluene	1,000,000	1,000,000	500,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
trans-1,2-Dichloroethene	1,000,000	1,000,000	50,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
trans-1,3-Dichloropropene	4,000	5,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Trichloroethene	23,000	54,000	1,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
VinylChloride	2,000	7,000	10,000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U
Xylene(Total)	410,000	1,000,000	10000	130 U	130 U	130 U	130 U	130 U	120 U	130 U	120 U	150 U	1.0 U	120 U

All samples collected 10/16/97

QUALIFIERS:

U Compound not detected at the indicated concentration

B Analyte detected in laboratory blank as well as sample, indicative of possible laboratory contamination of the environmental sample

NOTES:

[a] NJDEP Soil Cleanup Criteria (7/11/96)

[b] RDC-SCC = Residential Direct Contact Soil Cleanup Criteria

[c] NRDC-SCC = Non-Residential Direct Contact Soil Cleanup Criteria

[d] IGW-SCC = Impact to Ground Water Soil Cleanup Criteria

[e] Sample duplicate

[f] Field (rinsate) blank

[g] Trip blank

TABLE 4-4
DUMPING STATION AREA
SOIL SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP Criteria [a]			DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01	FB-101697
Laboratory Number >	RDC-SCC	NRDC-SCC	IGW-SCC	26830	26831	26833	26834	26835	26837	26838	26839	26847	26848
Units >	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/l
NOTES >	[b]	[c]	[d]			[e]							[f]
1,2-Dichlorobenzene	5,100,000	10,000,000	50,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
1,2,4-Trichlorobenzene	68,000	1,200,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
1,3-Dichlorobenzene	5,100,000	10,000,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
1,4-Dichlorobenzene	570,000	10,000,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Chloronaphthalene	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Chlorophenol	280,000	5,200,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Methylnaphthalene	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Methylphenol	2,800,000	10,000,000	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Nitroaniline	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2-Nitrophenol	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,4-Dichlorophenol	170,000	3,100,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,4-Dimethylphenol	1,100,000	10,000,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,4-Dinitrophenol	110,000	2,100,000	10,000	730 U	800 U	770 U	680 U	740 U	690 U	740 U	710 U	770 U	21 U
2,4-Dinitrotoluene	1,000	4,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,4,5-Trichlorophenol	5,600,000	10,000,000	50,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,4,6-Trichlorophenol	62,000	270,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
2,6-Dinitrotoluene	1,000	4,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
3-Nitroaniline	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
3,3'-Dichlorobenzidine	2,000	6,000	100,000	730 U	800 U	770 U	680 U	740 U	690 U	740 U	710 U	770 U	21 U
4-Bromophenyl-phenylether	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Chloro-3-methylphenol	10,000,000	10,000,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Chloroaniline	230,000	4,200,000	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Chlorophenyl-phenylether	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Methylphenol	2,800,000	10,000,000	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Nitroaniline	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
4-Nitrophenol	NA	NA	NA	730 U	800 U	770 U	680 U	740 U	690 U	740 U	710 U	770 U	21 U
4,6-Dinitro-2-methylphenol	NA	NA	NA	730 U	800 U	770 U	680 U	740 U	690 U	740 U	710 U	770 U	21 U
Acenaphthene	3,400,000	10,000,000	100,000	18 U	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Acenaphthylene	NA	NA	NA	18 U	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Anthracene	10,000,000	10,000,000	100,000	8.8 J	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Benzo(a)anthracene	900	4,000	500,000	37	20 U	19 U	17 U	18 U	11 J	18 U	18 U	19 U	11 U
Benzo(a)pyrene	660	660	100,000	32	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Benzo(b)fluoranthene	900	4,000	50,000	59	20 U	19 U	17 U	18 U	17 J	18 U	18 U	19 U	11 U
Benzo(g,h,i)perylene	NA	NA	NA	20	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Benzo(k)fluoranthene	900	4,000	500,000	21	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
bis(2-Chloroethoxy)methane	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
bis(2-Chloroethyl)ether	660	3,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
bis(2-chloroisopropyl)ether	2,300,000	10,000,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
bis(2-Ethylhexyl)phthalate	49,000	210,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Butylbenzylphthalate	1,100,000	10,000,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Carbazole	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Chrysene	9,000	40,000	500,000	48	20 U	19 U	17 U	18 U	12 J	18 U	18 U	19 U	11 U
Dibenzofuran	NA	NA	NA	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Dibenz(a,h)anthracene	660	660	100,000	18 U	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Diethylphthalate	10,000,000	10,000,000	50,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Dimethylphthalate	10,000,000	10,000,000	50,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Di-n-butylphthalate	5,700,000	10,000,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Di-n-octylphthalate	1,100,000	10,000,00	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Fluoranthene	2,300,000	10,000,000	100,000	85	20 U	19 U	17 U	18 U	25	18 U	18 U	19 U	11 U
Fluorene	2,300,000	10,000,000	100,000	18 U	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Hexachlorobenzene	660	2,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Hexachlorobutadiene	1,000	21,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Hexachlorocyclopentadiene	400,000	7,300,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Hexachloroethane	6,000	100,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Indeno(1,2,3-cd)pyrene	900	4,000	500,000	20	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Isophorone	1,100,000	10,000,000	50,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Naphthalene	230,000	4,200,000	100,000	18 U	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Nitrobenzene	28,000	520,000	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
N-Nitroso-di-n-propylamine	660	660	10,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
N-Nitrosodiphenylamine	140,000	600,000	100,000	370 U	400 U	380 U	340 U	370 U	340 U	370 U	350 U	380 U	11 U
Pentachlorophenol	6,000	24,000	100,000	730 U	800 U	770 U	680 U	740 U	690 U	740 U	710 U	770 U	21 U
Phenanthrene	NA	NA	NA	25	20 U	19 U	17 U	18 U	17 U	18 U	18 U	19 U	11 U
Phenol	10,000,000	10,000,000	50,000	370 U	400 U	380 U	340 U	11 J	340 U	370 U	350 U	380 U	11 U
Pyrene	1,700,000	10,000,000	100,000	52	20 U	19 U	9.0 J	18 U	20	18 U	18 U	19 U	11 U

All samples collected 10/16/97

QUALIFIERS:

U: Compound not detected at the indicated concentration

B: Analyte detected in laboratory blank as well as sample; indicative of possible laboratory contamination of the environmental sample

J: Mass spectral data indicate presence of a compound that meets identification criteria; result is less than the specified quantitation limit but greater than zero; concentration is approximate value

NOTES:

[a]: NJDEP Soil Cleanup Criteria (7/11/96)

[b]: RDC-SCC = Residential Direct Contact Soil Cleanup Criteria

[c]: NRDC-SCC = Non-Residential Direct Contact Soil Cleanup Criteria

[d]: IGW-SCC = Impact to Ground Water Soil Cleanup Criteria

[e]: Sample duplicate

[f]: Field (rinsate) blank

TABLE 4-5
DUMPING STATION AREA
SOIL PESTICIDE / PCB ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP Criteria [a]			DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01	FB-101697
Laboratory Number >	RDC-SCC	NRDC-SCC	IGW-SCC	26830	26831	26833	26834	26835	26837	26838	26839	26847	26848
Units >	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/l
NOTES >	[b]	[c]	[d]			[e]							[f]
Aldrin	40	170	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
alpha-BHC	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
beta-BHC	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
delta-BHC	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
gamma-BHC(Lindane)	520	2,200	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Chlordane	NA	NA	NA	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
4,4'-DDD	3,000	12,000	50,000	7.3	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	8.5	3.8 U	0.05 U
4,4'-DDE	2,000	9,000	50,000	16	4.4	3.9	11	3.7 U	3.4 U	3.7 U	44	18	0.05 U
4,4'-DDT	2,000	9,000	500,000	4.2	4.0 U	3.8 U	5.2	3.7 U	3.4 U	3.7 U	41	8.2	0.05 U
Dieldrin	42	180	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Endosulfan I	340,000	6,200,000	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Endosulfan II	340,000	6,200,000	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Endosulfansulfate	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Endrin	17,000	310,000	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Endrinaldehyde	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Heptachlor	150	650	50,000	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Heptachlorepoxide	NA	NA	NA	3.7 U	4.0 U	3.8 U	3.4 U	3.7 U	3.4 U	3.7 U	3.5 U	3.8 U	0.05 U
Toxaphene	100	200	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1016	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1221	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1232	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1242	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1248	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1254	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U
Aroclor-1260	490	2,000	50,000	75 U	81 U	78 U	69 U	75 U	70 U	75 U	72 U	78 U	1.0 U

All samples collected 10/16/97

QUALIFIERS:

U: Compound not detected at the indicated concentration

NOTES:

[a]: NJDEP Soil Cleanup Criteria (7/11/96)
[b]: RDC-SCC = Residential Direct Contact Soil Cleanup Criteria
[c]: NRDC-SCC = Non-Residential Direct Contact Soil Cleanup Criteria
[d]: IGW-SCC = Impact to Ground Water Soil Cleanup Criteria
[e]: Sample duplicate
[f]: Field (rinsate) blank

TABLE 4-6
DUMPING STATION AREA
SOIL METALS ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP Criteria [a]			DS-B1-SS1-01	DS-B1-SS2-01	DS-B1-SS2-02	DS-B2-SS1-01	DS-B2-SS2-01	DS-B3-SS1-01	DS-B3-SS2-01	DS-B4-SS1-01	DS-B4-SS2-01	FB-101697
Laboratory Number >	RDC-SCC	NRDC-SCC	IGW-SCC	26830	26831	26833	26834	26835	26837	26838	26839	26847	26848
Units >	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/l
NOTES >	[b]	[c]	[d]			[e]							[f]
Aluminum	NA	NA	NA	6,010 *	3,360 *	2,700 *	931 *	1,450 *	2,310 *	1,980 *	5,140 *	1,400 *	74.6 U
Antimony	14,000	340,000	NA	1.2 U	1.3 U	1.2 U	1.1 U	1.2 U	1.1 U	1.2 U	1.1 U	1.2 U	5.3 U
Arsenic	20,000	20,000	NA	6.7	1.9	2.0	1.7	1.5	2.4	2.3	3.7	1.1 B	3.9 B
Barium	700,000	47,000,000	NA	20.3 B	11.8 B	14.1 B	38.3 B	23.8 B	12.4 B	9.0 B	21.4 B	2.1 B	1.6 U
Beryllium	1,000	1,000	NA	0.24 B	0.11 B	0.07 B	0.062 U	0.067 U	0.08 B	0.067 U	0.14 B	0.070 U	0.30 U
Cadmium	1,000	100,000	NA	0.089 U	0.097 U	0.093 U	0.083 U	0.089 U	0.084 U	0.089 U	0.086 U	0.093 U	0.40 U
Calcium	NA	NA	NA	868 B	878 B	717 B	393 B	388 B	400 B	448 B	643 B	319 B	71.8 U
Chromium	NA	NA	NA	20.3 *	8.2 *	6.7 *	3.7 *	4.1 *	5.9 *	5.5 *	12.7 *	2.4 *	1.7 U
Cobalt	NA	NA	NA	2.4 B	2.2 B	2.0 B	0.69 B	0.73 B	0.77 B	0.87 B	2.2 B	0.65 B	1.3 U
Copper	600,000	600,000	NA	10.0	4.7 B	4.1 B	29.6	5.2 B	24.3	8.0	9.7	2.6 B	4.0 U
Iron	NA	NA	NA	10,100 *	5,070 *	4,590 *	1,710 *	2,350 *	3,660 *	3,250 *	9,010 *	1,500 *	44.2 U
Lead	400,000	600,000	NA	17.0 *	2.5 *	2.2 *	15.9 *	2.2 *	15.4 *	1.9 *	7.0 *	3.8 *	2.2 U
Magnesium	NA	NA	NA	2,020	1,230	1,020 B	366 B	515 B	646 B	753 B	1,650	288 B	58.8 U
Manganese	NA	NA	NA	70.6 *	43.4 *	35.3 *	22.4 *	26.2 *	23.5 *	26.6 *	66.1 *	15.2 *	1.2 U
Mercury	14,000	270,000	NA	0.14	0.020 U	0.019 U	0.017 U	0.019 U	0.017 U	0.019 U	0.018 U	0.019 U	0.10 U
Nickel	250,000	2,400,000	NA	7.6 B	5.4 B	5.2 B	1.5 B	2.0 B	2.4 B	2.6 B	5.6 B	3.4 B	1.3 U
Potassium	NA	NA	NA	1,010 B	603 B	523 B	177 B	257 B	352 B	372 B	821 B	130 B	372 U
Selenium	63,000	3,100,000	NA	1.1 U	1.2 U	1.1 U	0.99 U	1.1 U	1.0 U	1.1 U	1.0 U	1.1 U	4.8 U
Silver	110,000	4,100,000	NA	0.46 B	0.29 U	0.28 U	0.25 U	0.27 U	0.25 U	0.27 U	0.39 B	0.28 U	1.2 U
Sodium	NA	NA	NA	336 B	172 B	148 B	105 U	114 U	203 B	147 B	313 B	169 B	721 B
Thallium	2,000	2,000	NA	0.85 U	0.92 U	0.88 U	0.79 U	0.85 U	0.80 U	0.85 U	0.81 U	0.88 U	3.8 U
Vanadium	370,000	7,100,000	NA	21.7	9.2 B	7.3 B	3.3 B	4.0 B	6.5 B	5.7 B	16.5	2.4 B	2.5 U
Zinc	1,500,000	1,500,000	NA	47.1	31.9	32.4	52.0	26.7	12.8	10.6	29.2	17.2	5.7 B

All samples collected 10/16/97

QUALIFIERS:

- * Duplicate analysis not within control limits
- U: Compound not detected at the indicated concentration
- B: Reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL)

NOTES:

[a]: NJDEP Soil Cleanup Criteria (7/11/96)
[b]: RDC-SCC = Residential Direct Contact Soil Cleanup Criteria
[c]: NRDC-SCC = Non-Residential Direct Contact Soil Cleanup Criteria
[d]: IGW-SCC = Impact to Ground Water Soil Cleanup Criteria
[e]: Sample duplicate
[f]: Field (rinsate) blank

TABLE 4-7
DUMPING STATION AREA
GROUND WATER VOLATILE ORGANIC COMPOUND ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02
Laboratory Number >	GWQS	26840	26842	26843
Units >	ug/l	ug/l	ug/l	ug/l
NOTES >	[a]			[b]
1,1-Dichloroethane	70	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	2	1.0 U	1.0 U	1.0 U
1,1,1-Trichloroethane	30	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	3	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	2	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	2	1.0 U	1.0 U	1.0 U
1,2-Dichloropropane	1	1.0 U	1.0 U	1.0 U
2-Butanone	300	5.0 U	5.0 U	5.0 U
2-Hexanone	NA	5.0 U	5.0 U	5.0 U
4-Methyl-2-Pentanone	400	5.0 U	5.0 U	5.0 U
Acetone	700	5.0 U	5.0 U	5.0 U
Benzene	1	1.0 U	1.0 U	1.0 U
Bromodichloromethane	1	1.0 U	1.0 U	1.0 U
Bromoform	4	1.0 U	1.0 U	1.0 U
Bromomethane	10	1.0 U	1.0 U	1.0 U
CarbonDisulfide	NA	1.0 U	1.0 U	1.0 U
CarbonTetrachloride	2	1.0 U	1.0 U	1.0 U
Chlorobenzene	50	1.0 U	1.0 U	1.0 U
Chloroethane	NA	1.0 U	1.0 U	1.0 U
Chloroform	6	1.0 U	1.0 U	1.0 U
Chloromethane	30	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	NA	1.0 U	1.0 U	1.0 U
Dibromochloromethane	10	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	1.0 U	1.0 U	1.0 U
MethyleneChloride	3	1.0 U	1.0 U	1.0 U
Styrene	100	1.0 U	1.0 U	1.0 U
Tetrachloroethene	1	1.0 U	1.0 U	1.0 U
Toluene	1,000	1.0 U	1.0 U	0.7 J
trans-1,2-Dichloroethene	100	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	NA	1.0 U	1.0 U	1.0 U
Trichloroethene	1	1.0 U	1.0 U	1.0 U
VinylChloride	5	1.0 U	1.0 U	1.0 U
Xylene(Total)	1,000	1.0 U	1.0 U	1.0 U

All samples collected 10/16/97

QUALIFIERS:

U: Compound not detected at the indicated concentration

NOTES:

[a]: NJDEP Ground Water Quality Standards - Class II-A: NJAC 7:9-6; and State Primary Drinking Water Standards: NJAC 7:10-5.1, 5.2

[b]: Sample duplicate

TABLE 4-8
DUMPING STATION AREA
GROUND WATER SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02
Laboratory Number >	GWQS	26840	26842	26843
Units >	ug/l	ug/l	ug/l	ug/l
NOTES >	[a]			[b]
1,2-Dichlorobenzene	600	10 U	10 U	10 U
1,2,4-Trichlorobenzene	9	10 U	10 U	10 U
1,3-Dichlorobenzene	600	10 U	10 U	10 U
1,4-Dichlorobenzene	75	10 U	10 U	10 U
2-Chloronaphthalene	NA	10 U	10 U	10 U
2-Chlorophenol	40	10 U	10 U	10 U
2-Methylnaphthalene	NA	10 U	10 U	10 U
2-Methylphenol	NA	10 U	10 U	10 U
2-Nitroaniline	NA	10 U	10 U	10 U
2-Nitrophenol	NA	10 U	10 U	10 U
2,4-Dichlorophenol	20	10 U	10 U	10 U
2,4-Dimethylphenol	100	10 U	10 U	10 U
2,4-Dinitrophenol	40	21 U	21 U	21 U
2,4-Dinitrotoluene	10	10 U	10 U	10 U
2,4,5-Trichlorophenol	700	10 U	10 U	10 U
2,4,6-Trichlorophenol	20	10 U	10 U	10 U
2,6-Dinitrotoluene	NA	10 U	10 U	10 U
3-Nitroaniline	NA	10 U	10 U	10 U
3,3'-Dichlorobenzidine	60	21 U	21 U	21 U
4-Bromophenyl-phenylether	NA	10 U	10 U	10 U
4-Chloro-3-methylphenol	NA	10 U	10 U	10 U
4-Chloroaniline	NA	10 U	10 U	10 U
4-Chlorophenyl-phenylether	NA	10 U	10 U	10 U
4-Methylphenol	NA	10 U	10 U	10 U
4-Nitroaniline	NA	10 U	10 U	10 U
4-Nitrophenol	NA	21 U	21 U	21 U
4,6-Dinitro-2-methylphenol	NA	21 U	21 U	21 U
Acenaphthene	400	10 U	10 U	10 U
Acenaphthylene	NA	10 U	10 U	10 U
Anthracene	2,000	10 U	10 U	10 U
Benzo(a)anthracene	NA	10 U	10 U	10 U
Benzo(a)pyrene	NA	10 U	10 U	10 U
Benzo(b)fluoranthene	NA	10 U	10 U	10 U
Benzo(g,h,i)perylene	NA	10 U	10 U	10 U
Benzo(k)fluoranthene	NA	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	NA	10 U	10 U	10 U
bis(2-Chloroethyl)ether	10	10 U	10 U	10 U
bis(2-chloroisopropyl)ether	300	10 U	10 U	10 U
bis(2-Ethylhexyl)phthalate	30	10 U	10 U	10 U
Butylbenzylphthalate	100	10 U	10 U	10 U
Carbazole	NA	10 U	10 U	10 U
Chrysene	NA	10 U	10 U	10 U
Dibenzofuran	NA	10 U	10 U	10 U
Dibenz(a,h)anthracene	NA	10 U	10 U	10 U
Diethylphthalate	5,000	10 U	10 U	10 U
Dimethylphthalate	NA	10 U	10 U	10 U
Di-n-butylphthalate	900	10 U	10 U	10 U
Di-n-octylphthalate	100	10 U	10 U	10 U
Fluoranthene	300	10 U	10 U	10 U
Fluorene	300	10 U	10 U	10 U
Hexachlorobenzene	10	10 U	10 U	10 U
Hexachlorobutadiene	1	10 U	10 U	10 U
Hexachlorocyclopentadiene	50	10 U	10 U	10 U
Hexachloroethane	10	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	NA	10 U	10 U	10 U
Isophorone	100	10 U	10 U	10 U
Naphthalene	NA	10 U	10 U	10 U
Nitrobenzene	10	10 U	10 U	10 U
N-Nitroso-di-n-propylamine	20	10 U	10 U	10 U
N-Nitrosodiphenylamine	20	10 U	10 U	10 U
Pentachlorophenol	1	21 U	21 U	21 U
Phenanthrene	NA	10 U	10 U	10 U
Phenol	4,000	10 U	10 U	10 U
Pyrene	200	10 U	10 U	10 U

All samples collected 10/16/97

QUALIFIERS:

U: Compound not detected at the indicated concentration

NOTES:

[a]: NJDEP Ground Water Quality Standards - Class II-A: NJAC 7:9-6; and State Primary Drinking Water Standards: NJAC 7:10-5.1, 5.2

[b]: Sample duplicate

TABLE 4-9
DUMPING STATION AREA
GROUND WATER PESTICIDE / PCB ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02
Laboratory Number >	GWQS	26840	26842	26843
Units >	ug/l	ug/l	ug/l	ug/l
NOTES >	[a]		[b]	[b], [c]
Aldrin	0.04	0.05 U	0.05 U	0.05 U
alpha-BHC	0.02	0.05 U	0.05 U	0.05 U
beta-BHC	0.2	0.05 U	0.05 U	0.05 U
delta-BHC	NA	0.05 U	0.05 U	0.05 U
gamma-BHC(Lindane)	0.2	0.05 U	0.05 U	0.05 U
Chlordane	0.5	1.0 U	1.0 U	1.0 U
4,4'-DDD	0.1	0.05 U	0.05 U	0.05 U
4,4'-DDE	0.1	0.05 U	***0.13***	0.095
4,4'-DDT	0.1	0.05 U	***0.16***	***0.11***
Dieldrin	0.03	0.05 U	0.05 U	0.05 U
Endosulfan I	0.4	0.05 U	0.05 U	0.05 U
Endosulfan II	0.4	0.05 U	0.05 U	0.05 U
Endosulfansulfate	0.4	0.05 U	0.05 U	0.05 U
Endrin	2	0.05 U	0.05 U	0.05 U
Endrinaldehyde	NA	0.05 U	0.05 U	0.05 U
Heptachlor	0.4	0.05 U	0.05 U	0.05 U
Heptachlor epoxide	0.2	0.05 U	0.05 U	0.05 U
Toxaphene	3	1.0 U	1.0 U	1.0 U
Aroclor-1016	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1221	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1232	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1242	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1248	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1254	0.5	1.0 U	1.0 U	1.0 U
Aroclor-1260	0.5	1.0 U	1.0 U	1.0 U

All samples collected 10/16/97

QUALIFIERS:

U: Compound not detected at the indicated concentration

NOTES:

[a]: NJDEP Ground Water Quality Standards - Class II-A: NJAC 7:9-6; and State Primary Drinking Water Standards: NJAC 7:10-5.1, 5.2

[b]: ***Bold*** values exceed NJDEP GWQS

[c]: Sample duplicate

TABLE 4-10
DUMPING STATION AREA
GROUND WATER METALS ANALYTICAL DATA
FORMER NAVAL AIR STATION, CAPE MAY, NEW JERSEY

Sample Designation >	NJDEP	DS-B1-GW-01	DS-B1-GW-01	DS-B3-GW-01	DS-B3-GW-02	DS-B3-GW-01	DS-B3-GW-02
Laboratory Number >	GWQS	26840	26849	26842	26843	26850	26851
Matrix >	---	Total	Dissolved	Total	Total	Dissolved	Dissolved
Units >	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
NOTES >	[a]	[b]	[b]	[b]	[b], [c]	[b]	[b], [c]
Aluminum	200	***3,090*** N	74.6 UN	***57,000*** N	***19,200*** N	***419*** N	***521*** N
Antimony	20	5.3 U	5.3 U	16.2	17.6	15.1	9.0 B
Arsenic	8	4.8	3.4 U	***39.1***	***18.5***	3.4 U	3.7 B
Barium	2,000	40.0 B	30.3 B	303	124 B	29.4 B	31.5 B
Beryllium	20	0.30 U	0.30 U	3.0	1.2 B	0.30 U	0.30 U
Cadmium	4	0.40 U	0.40 U	0.58 B	0.50 B	0.40 U	0.40 U
Calcium	NA	236,000	242,000	68,100	78,500	82,500	82,500
Chromium	100	9.1 B	1.7 U	***230***	54.7	3.4 B	5.4 B
Cobalt	NA	2.4 B	1.3 U	30.4 B	10.4 B	4.3 B	5.8 B
Copper	1,000	6.3 B	25.7	398	245	102	117
Iron	300	***7,070***	***1,540***	***83,800***	***23,500***	***1,640***	***1,320***
Lead	10	2.2 U	2.2 U	***327***	***76.1***	2.2 U	2.2 U
Magnesium	NA	199,000	209,000	114,000	128,000	134,000	134,000
Manganese	50	***1,640***	***1,720***	***1,610***	***1,350***	***1,310***	***1,310***
Mercury	2	0.10 U	0.10 U	0.95	0.73	0.19 B	0.21
Nickel	100	13.9 B	12.8 B	***129***	45.2	34.6 B	26.7 B
Potassium	NA	51,400	54,000	59,600	60,600	59,800	60,500
Selenium	50	4.8 U	4.8 U	9.6 U	4.8 U	4.8 U	4.8 U
Silver	NA	1.2 U	1.2 U	1.6 B	1.2 U	1.2 U	1.2 U
Sodium	50,000	***1,110,000***	***1,200,000***	***1,040,000***	***1,170,000***	***1,200,000***	***1,220,000***
Thallium	10	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U	3.8 U
Vanadium	NA	8.3 B	2.5 U	121	44.1 B	2.5 U	3.8 B
Zinc	5,000	39.4	31.5	1,470	741	170	199

All samples collected 10/16/97

QUALIFIERS:

N: Spiked sample recovery not within control limits
U: Compound not detected at the indicated concentration
B: Reported value is less than the Method Detection Limit (MDL) but greater than or equal to the Instrument Detection Limit (IDL)

NOTES:

[a] NJDEP Ground Water Quality Standards - Class II-A: NJAC 7:9-6; State Primary Drinking Water Standards: NJAC 7:10-5.1, 5.2
[b] ***Bold*** values exceed NJDEP GWQS
[c] Sample duplicate

SOIL BORING LOG

PROJECT NUMBER: 7-7076-0008	PROJECT NAME: NAVAL AIR STATION, CAPE MAY NJ		
BORING NUMBER: DS-B1	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10/16/97
ENGINEER/GEOLOGIST: R. Sussko	Depth	Date/Time	DATE COMPLETED: 10/16/97
DRILLING METHODS: GEO PROBE			PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	SS-1		21"	GRAY & TAN M-F SANDS, TRACE SILT. HS: 0ppm				1" TOP SOIL; HARD 1" CLAY LAYER ≈ .9'
	SS-2		23"	GRAY & TAN M-F SANDS, TRACE SILT HS: 0ppm.				SAMPLE WET @ ≈ 2.5'
5								
								SAMPLE DS-B1-SS1-1'; SAMPLE DS-B1-SS2-2'; DUP FROM SS-2

NOTES: SET SCREEN FROM 3'-7' FOR WATER COLLECTION.

SOIL BORING LOG

PROJECT NUMBER: 7-7076-0008	PROJECT NAME: NAVAL AIR STATION, CAPE MAY NJ	
BORING NUMBER: DS-B2	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 10/16/97
ENGINEER/GEOLOGIST: R. Sussko	Depth Date/Time	DATE COMPLETED: 10/16/97
DRILLING METHODS: GeoProbe		PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	SS-1		22"	SS-1A: BLACK & GRAY M-F SAND, TRACE SILT SS-1B: GRAY M-F SANDS, TRACE SILT HS=0				1" TOPSOIL
	SS-2		20"	SS-2: GRAY M-F SANDS, TRACE SILT HS=0				WATER ≈ 3.7'
5								
								SAMPLE DS-B2-SS1 - 3' SAMPLE DS-B2-SS2 - 3.5'

NOTES:

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

SOIL BORING LOG

PROJECT NUMBER: 7-7076-0008	PROJECT NAME: NAVAL AIR STATION CAPE MAY NJ		
BORING NUMBER: DS-33	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10/16/97
ENGINEER/GEOLOGIST: R. SUSSKO	Depth	Date/Time	DATE COMPLETED: 10/16/97
DRILLING METHODS: GEOPROBE			PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	SS-1			SS-1A: BROWN/BLACK M-F SAND TRACE SILT SS-B GRAY & TAN M-F SAND, TRACE SILT HS = 0 ppm				TOP ... TOPSOIL SS-1A - 1'
	SS-2			SS-2 GRAY & TAN M-F SAND, TRACE SILT HS = 0 ppm				WATER @ ≈ 3.7'
5								SAMPLE DS-33-SS1 - 2' SAMPLE DS-33-SS2 - 3.5'

NOTES: SET SCREEN @ 4'-8' FOR WATER SAMPLING.

SOIL BORING LOG

PROJECT NUMBER: 7-7076-0008	PROJECT NAME: NAVAL AIR STATION, CAPE MAY NJ		
BORING NUMBER: DS-B4	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 10/16/97
ENGINEER/GEOLOGIST: R. SUSSKO	Depth	Date/Time	DATE COMPLETED: 10/16/97
DRILLING METHODS: GEOPROBE			PAGE 1 OF 1

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	WELL CONSTRUCTION	REMARKS
	SS-1		23"	SS1A: BLACK/BROWN & GRAY M-F SAND, TRACE SILT SS-1B: TAN & GRAY SANDS, (M-F) TRACE SILT RUST STAINING				1" TOPSOIL 1/2" CLAY LAYER @ '
	SS-2		20"	SS-2A: DO SS-1B SS-2B, GRAY M-F SAND, TRACE SILT				
5								WATER ≈ 3.2'
								SAMPLE SS-1 @ 2'
								SAMPLE SS-2 @ 3'

NOTES:

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

APPENDIX D

Site Visit Photographs (2018)

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Photograph 1. AOC 1 Abandoned Dumping Station (northward)

Photograph 2. AOC 1 Abandoned Dumping Station (northward)

Photograph 3. AOC 1 Abandoned Dumping Station (northward)

Photograph 4. AOC 1 Abandoned Dumping Station (southward)

Photograph 5. AOC 1 Abandoned Dumping Station (southward)

Photograph 6. AOC 1 Abandoned Dumping Station – No Trespassing Sign

Photograph 7. AOC 1 Abandoned Dumping Station, Horseshoe Crab Shells

Photograph 8. AOC 1 Abandoned Dumping Station, Boundary Road

Photograph 9. AOC 1 Abandoned Dumping Station, Sheet Piling Beside Road

Photograph 10. AOC 1 Abandoned Dumping Station, Sheet Piling Beside Road

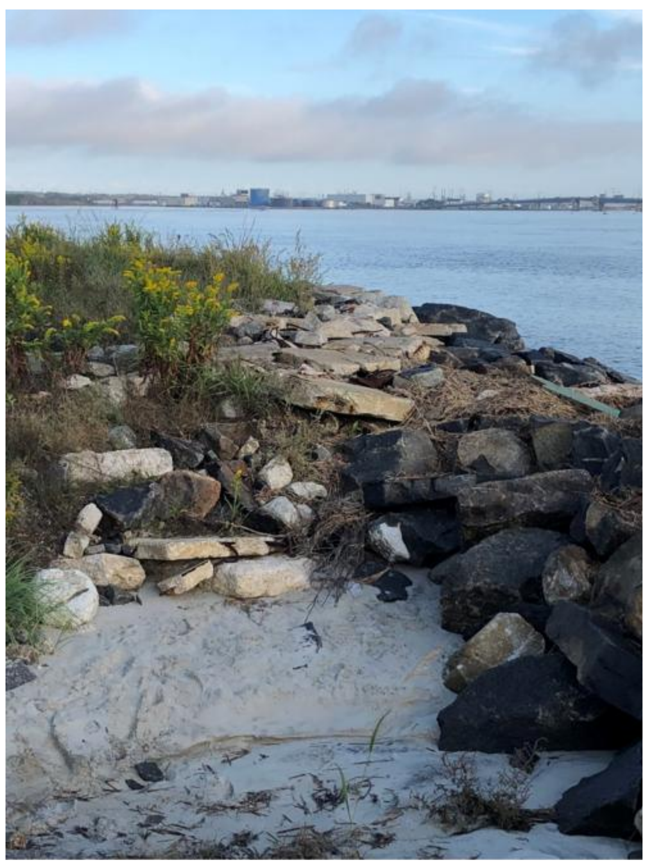
Photograph 11. AOC 1 Abandoned Dumping Station (northeastward, from road)

Photograph 12. AOC 1 Abandoned Dumping Station, Drainage Area

Photograph 13. AOC 1 Abandoned Dumping Station, Drainage Area (northward)

Photograph 14. AOC 1 Abandoned Dumping Station, Drainage Area (northward)

Photograph 15. AOC 1 Abandoned Dumping Station, Vegetation and Concrete Debris



Photograph 16. AOC 1 Abandoned Dumping Station, Drainage Area (northward)

Photograph 17. AOC 1 Abandoned Dumping Station (southward)

Photograph 18. AOC 2 Former Eastern Firing Range (northward)

Photograph 19. AOC 2 Former Eastern Firing Range, Phragmites at North Edge of Beach

Photograph 20. AOC 2 Former Eastern Firing Range, View of Jetty (southeastward)

Photograph 21. AOC 2 Former Eastern Firing Range, Phragmites Stands

Photograph 22. AOC 2 Former Eastern Firing Range, Beach (westward)

Photograph 23. AOC 2 Former Eastern Firing Range, Beach (northward)

Photograph 24. AOC 2 Former Eastern Firing Range, Warning Sign (northward)

Photograph 25. Concrete Bunker Between AOCs 2 and 3 (Former Firing Ranges)

Photograph 26. Concrete Bunker Between AOCs 2 and 3 (Former Firing Ranges)

Photograph 27. Example of Marsh Mat Found Between AOCs 2 and 3 (Former Firing Ranges)

Photograph 28. AOC 3 Former Western Firing Range (northward)

Photograph 29. Beach South of AOC 3 Former Western Firing Range (southwestward)

Photograph 30. AOC 3 Former Western Firing Range (northward)

Photograph 31. Vegetation Observed Near AOCs 2 and 3 Former Firing Ranges

Photograph 32. AOC 3 Former Western Firing Range, View from Firing Position

Photograph 33. AOC 3 Former Western Firing Range, Photo Provided by USCG of Spent Rounds Found on the Beach in November 2010

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APPENDIX E

Geologic Maps

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DEPARTMENT OF ENVIRONMENTAL PROTECTION
WATER RESOURCES MANAGEMENT
NEW JERSEY GEOLOGICAL AND WATER SURVEY

Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM

INTRODUCTION

Cape May County (fig. 1) is located in southernmost New Jersey. Demand for potable groundwater over the past several decades (figs. 2 and 3) has led to degradation of several aquifers in the region (Lacombe and Carlton, 2002). Water quality has degraded in the water table and confined aquifers due to saltwater intrusion, especially near the Atlantic Ocean coastline and, in places, along the Delaware Bay coastline. This is in major part due to large water-level drawdowns caused by pumping of large capacity water-supply wells in major confined aquifers in coastal areas in southernmost Cape May County (Lacombe and Carlton, 2002). Understanding the region's geologic and hydrogeological framework is critical for present and future water resource management, especially in light of present and future demands on potable water supply.

This map presents an updated geologic and hydrogeologic framework including cross sections highlighting the correlation between geologic formations and aquifers (fig. 4) and the extents and thicknesses of geologic formations (figs. 5-11) and major aquifers and confining units (figs. 12-18). It is important to have accurate geologic and hydrogeologic frameworks to better characterize the extent and thickness of the important aquifers in the region and provide realistic constraints for groundwater models. The data used in this report are from continuous coreholes (Cape May Coast Guard Station, Cape May Airport, Cape May Zoo, Ocean View, and Belleplain State Forest) and wireline gamma-ray logs from intervening water wells (table 1), and used to create a modern geologic and hydrodogeologic framework. The framework covers Coastal Plain formations from the upper Eocene Absecon Inlet Formation through the Pleistocene Cape May. We concentrate this study on well-characterized aquifers including the Piney Point (upper Oligocene), Atlantic City 800-foot sand (lower Miocene), Rio Grande water-bearing zone (lower-to-middle Miocene), Cohansey aquifer (middle Miocene), Estuarine sand aquifer (upper Miocene and Pleistocene), and Holly Beach water-bearing zone (Quaternary).

Cape May County is underlain by unconsolidated Coastal Plain formations of Cretaceous and younger age that are as much as 6,500 feet thick (Gill and Farlekas, 1976). The outcropping formations are predominantly Quaternary, including the Cape May Formation and fresh water wetland and saltmarsh deposits (fig. 1). The Tertiary age Bridgeton, and Cohansey Formations crop out in the north-northwestern part of the county (fig. 1). The geologic cross sections (figs. 5-11) show the lateral variation in thickness of upper Eocene age and younger outcropping and subsurface formations to depths of 600 to 1,500 feet (fig. 4). These formations contain sands which compose the major aquifers in the county (Gill, 1962a and b; Lacombe and Carleton, 2002). Deeper formations contain brackish water unfit for potable use and are not included in this study. Hydrogeologic cross sections highlighting the aquifer sands under Cape May County are presented on figures 12-18.

DESCRIPTION OF GEOLOGIC FORMATIONS

The Coastal Plain formations underlying Cape May County are composed primarily of unconsolidated gravel, sand, silt, and clay of marine, coastal deltaic, and fluvial origin. The oldest formations displayed in cross section are the Absecon Inlet (upper Eocene), Sewell Point (upper Eocene to lower Oligocene), and Atlantic City (upper Oligocene) Formations. These are shown only in the deepest wells (figs. 7, 9, and 11). The Absecon Inlet Formation is a fine-grained marine shelf deposit that records a period of high sea level. It consists predominantly of silts and clays that are occasionally glauconitic (Browning and others, 1997). The Sewell Point and Atlantic City Formations consist of glauconitic quartz sand and glauconitic silts and clays deposited in inner neritic environments (Pekar and others, 1997).

The lower-middle Miocene Kirkwood Formation reflects a major change from predominantly starved shelf sedimentation in the Oligocene to deltaic deposition (Browning and others, 2008). Coarsening-upward deltaic successions, consisting of fine-grained shelf and prodelta clay-silts overlain by coarser grained delta-front sands, characterize the members of the Kirkwood Formation and suggest that one or more river systems crossed New Jersey at this time (Browning and others, 2008). These

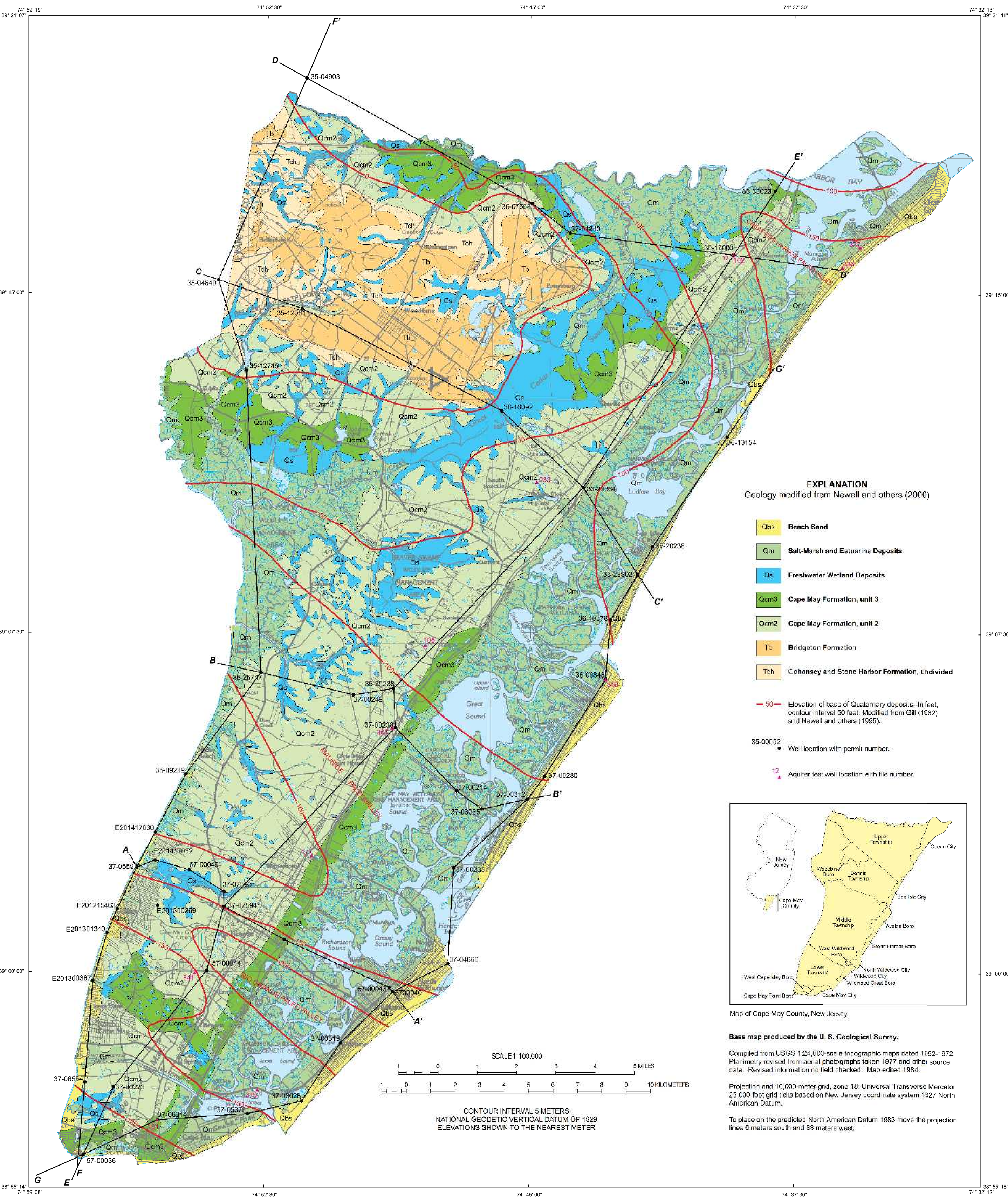


Figure 1. Geologic Map of Cape May County (modified from Newell and others, 2000) showing location of wells and lines of cross section.

Digital compilation by R.S. Pristas.
Cartography by R.S. Pristas and D.H. Monteverde.

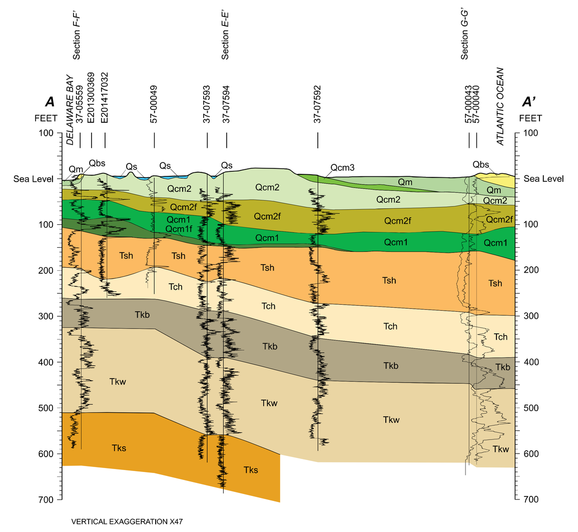
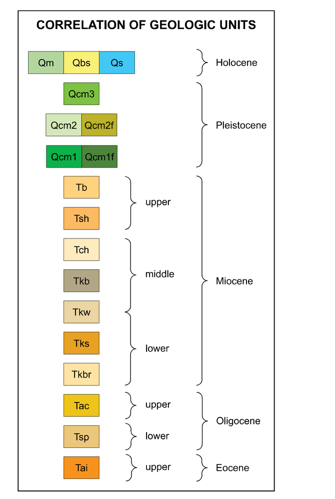


Figure 5. Geologic section *A-A'*



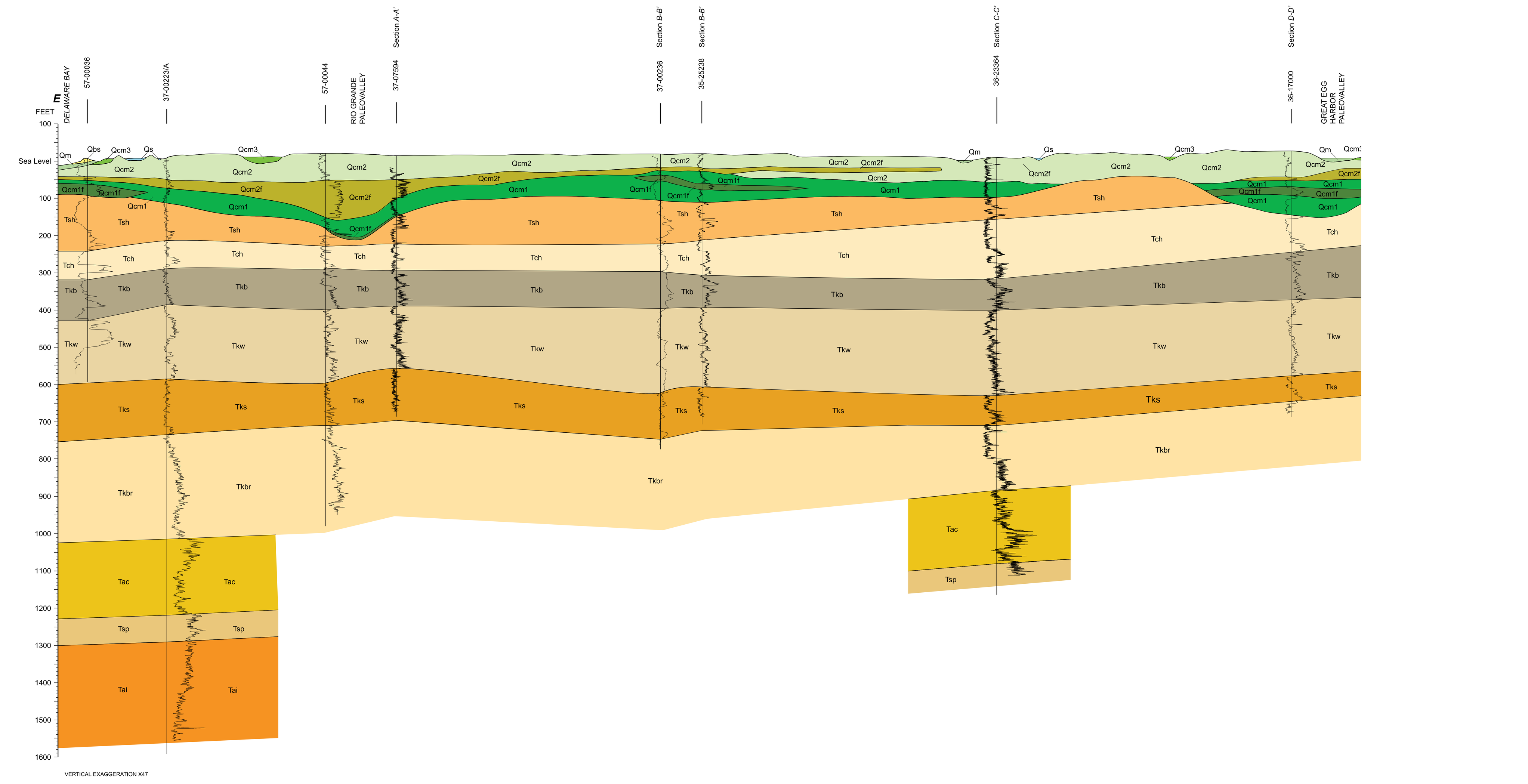


Figure 9. Geologic section *E-E'*

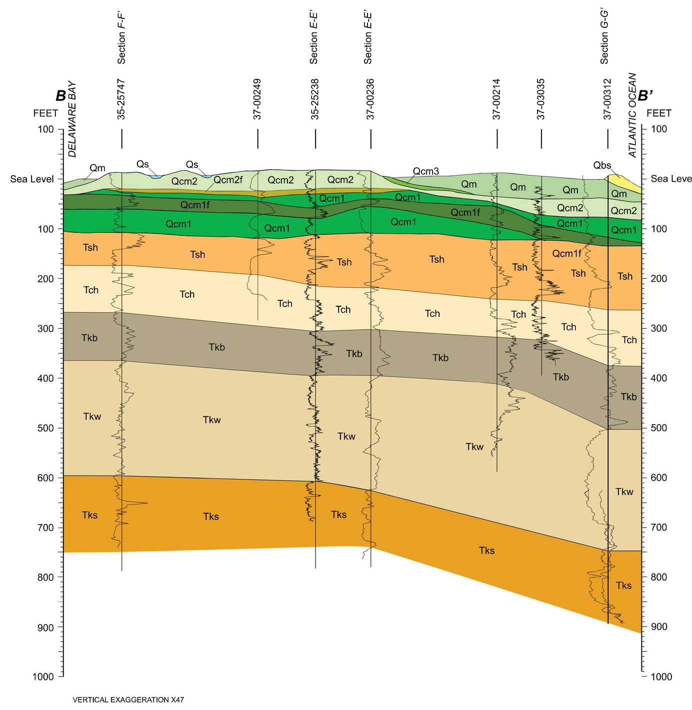


Figure 6. Geologic section *B-B'*

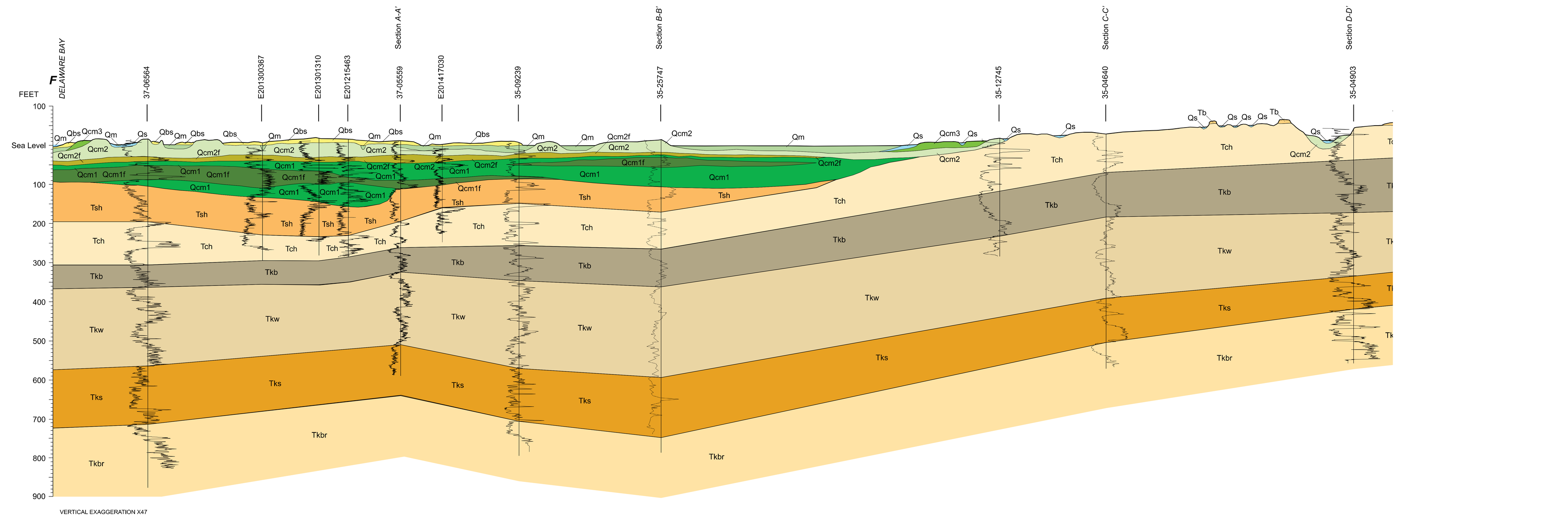


Figure 10. Geologic section *F-F'*

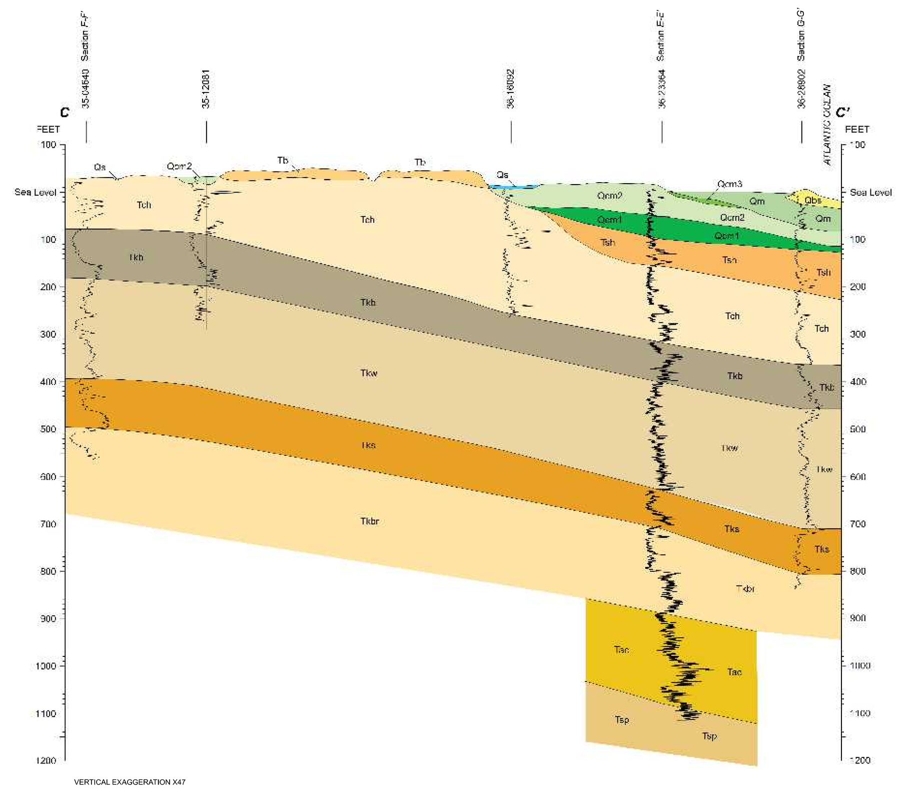


Figure 7. Geologic section *C-C'*

Atlantic City Formation - Consists of three facies in a vertical section, a lower glauconite sand, a middle clay-silt, and an upper quartz sand. The lower glauconite sand facies is a fine- to medium-grained, massive, clayey, moderate-green glauconite sand that contains between 10 and 20 percent quartz. Small shell fragments are abundant, and scattered mica is present in this facies. The lower facies grades into a massive to thick-bedded, medium- to dark-gray clay-silt which has common thin to thick interbeds of glauconite sand and abundant thin-walled mollusks. This facies is overlain by a fine- to coarse-grained (mostly medium- to coarse-grained), massive to thick-bedded, olive-gray to greenish-gray sand with scattered granules. Worn, rounded shell fragments are common in some of the sand beds. Quartz and glauconite proportions vary in these upper sand beds with the glauconite content ranging between 20 and 40 percent. Most of the glauconite grains are moderate brown to

It can be found between approximately 80 to 225 feet below land surface, the shallower depths being in the northwest area of its extent. A well drilled to a depth of 141 feet by a major water supply company and tested over a six hour period yielded 700 gpm with 61 feet of drawdown for a specific capacity of 9 gpm/ft. Chlorides and sodium above drinking water standards affect this aquifer in Cape May City, beneath barrier islands and bays, in the Villas area of Lower Township near Delaware Bay, and in the Sun Ray Beach and Del Haven areas of Middle Township. The aquifer supplies small percentages (less than 1 percent) of groundwater used in Cape May County. Future high capacity wells using this aquifer should be sited as far as possible from the bay and ocean.

The Holly Beach water-bearing zone is the surficial or water-table aquifer in the peninsular part of

Sugarman, P.J., Miller, K.G., Browning, J.V., Kulpecz, A.A., and McLaughlin, P.P., 2005, Hydrostratigraphy of the New Jersey Coastal Plain: Sequences and facies predict continuity of aquifers and confining units: Stratigraphy, v. 2, p. 259-275.

Sugarman, P.J., Miller, K.G., Owens, J.P., and Feigenson, M.D., 1993, Strontium isotope and sequence stratigraphy of the Miocene Kirkwood Formation, southern New Jersey: Geological Society of America Bulletin, v. 105, no. 4, p. 423-436.

Sugarman, P.J., Monteverde, D.H., Boyle, J.T., and Domber, S.E., 2013, Aquifer correlation map of Monmouth and Ocean Counties, New Jersey: New Jersey Geological Survey Geologic

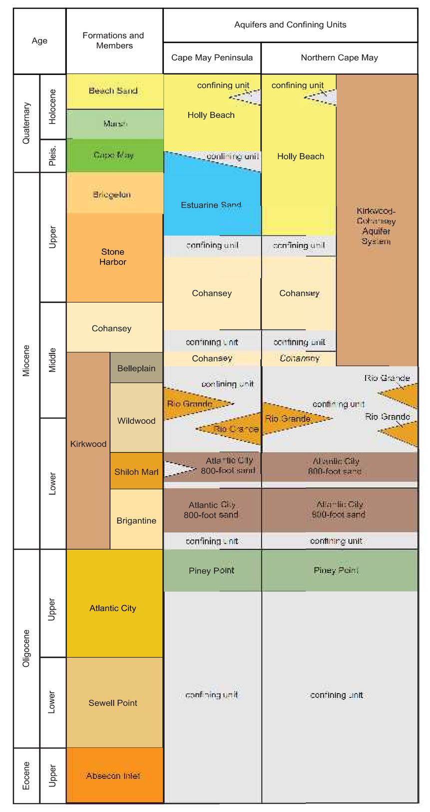
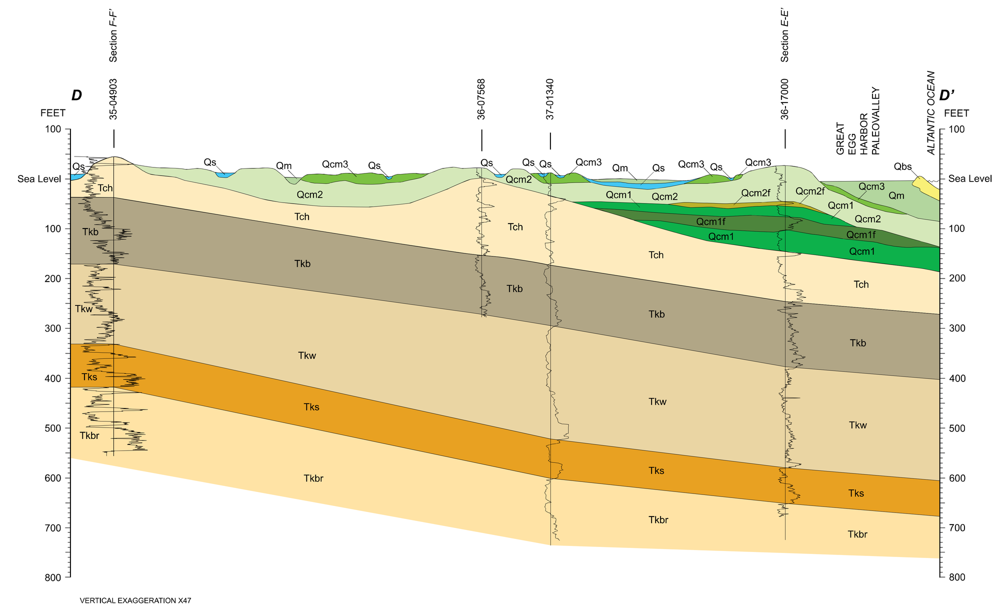


Figure 4. Generalized comparison of geologic formations, aquifers, and confining units in the study area. Also shown is the hydrogeologic framework (Sugarman and others).



VERTICAL EXAGGERATION X47

Figure 8. Geologic section *D-D'*

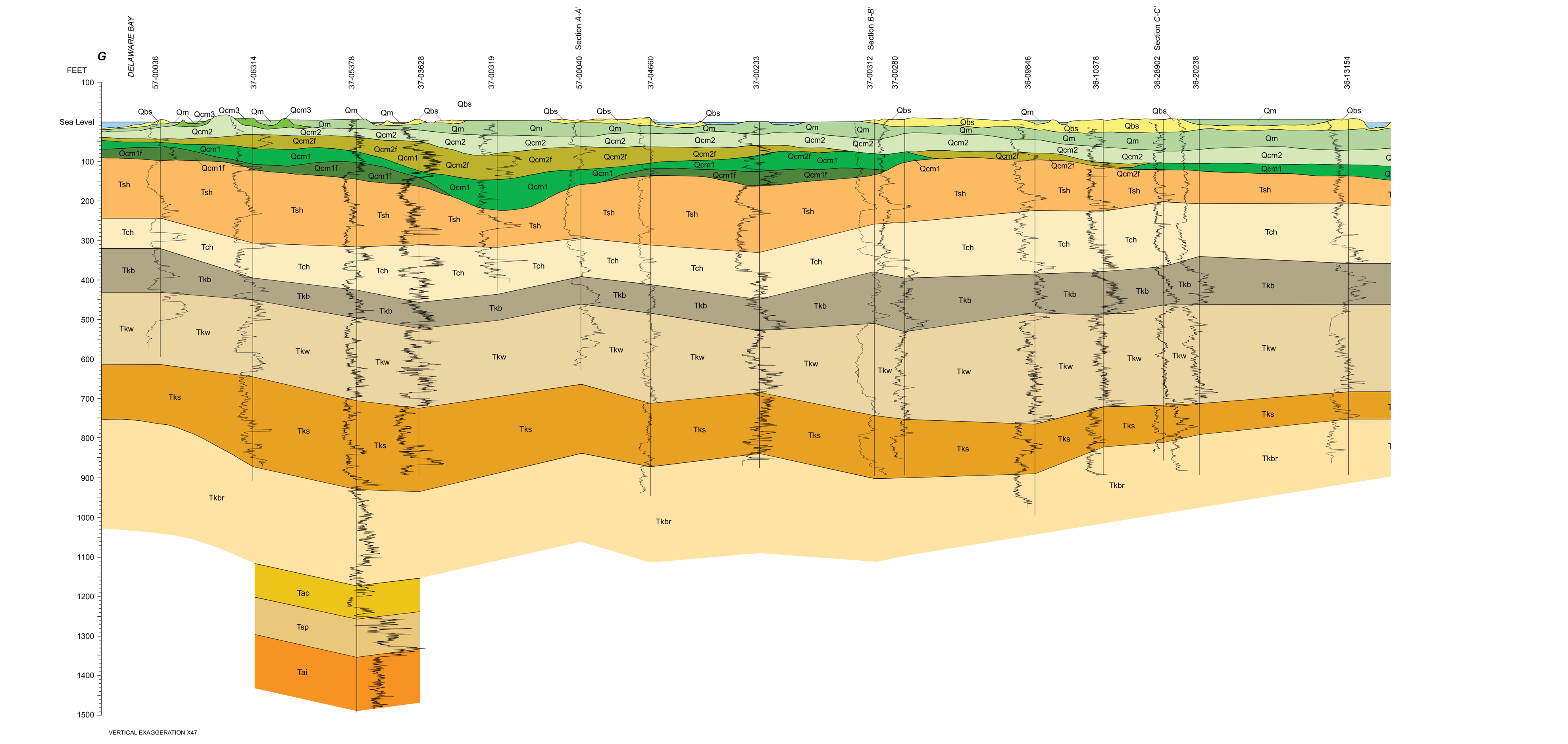


Figure 11. Geologic section *G-G'*

Geologic and Aquifer Map of Cape May County, New Jersey

by

Peter J. Sugarman, Donald H. Monteverde, Scott D. Stanford,
Stephen W. Johnson, Yelena Stroiteleva, Ronald S. Pristas,
Kathleen Vandegrift, and Steven E. Domber

2016

Prepared in cooperation with the
U.S. GEOLOGICAL SURVEY
NATIONAL GEOLOGIC MAPPING PROGRAM

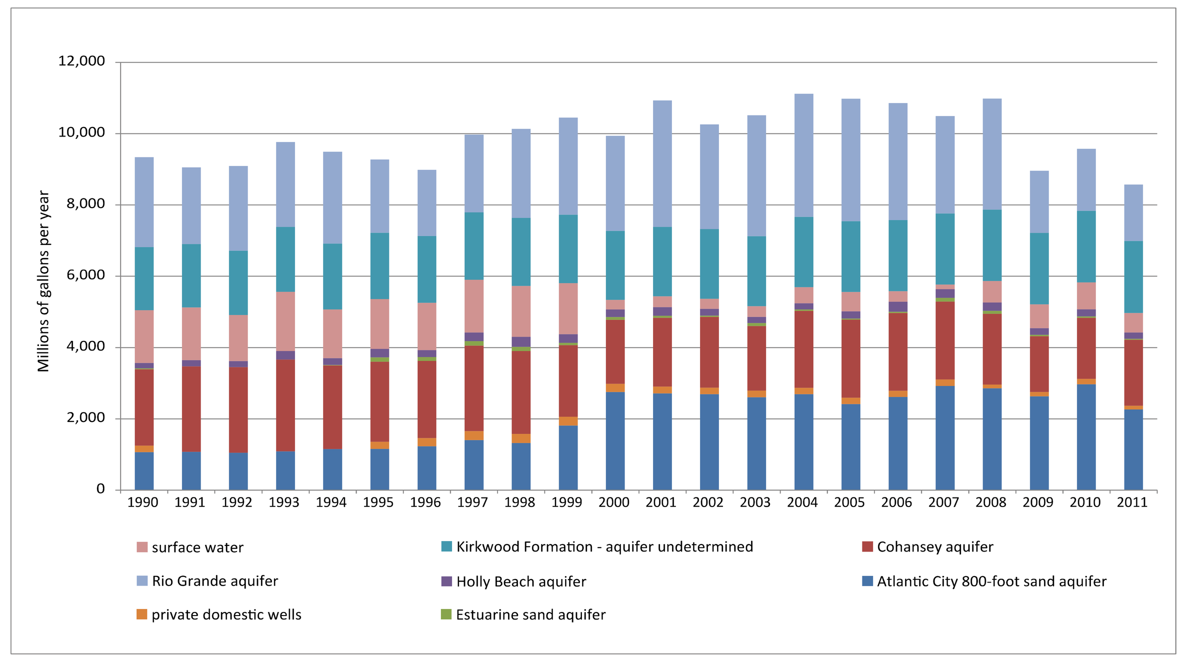


Figure 2. Fresh water annual withdrawals in Cape May County by source group, 1990 through 2011.

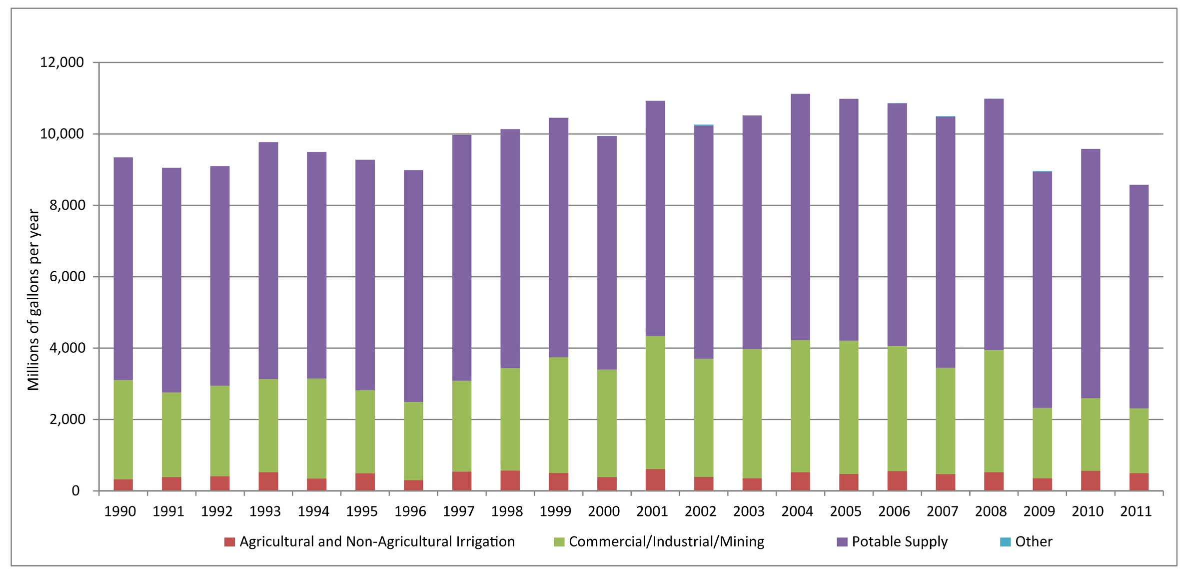


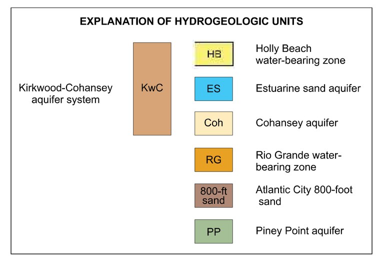
Figure 3. Fresh water annual withdrawals in Cape May County by user group, 1990 through 2011.

Table 1. Permit number, well location, total depth, and cross section of wells used in this study.

NJ Well Permit Number	County	Municipality	USGS Quadrangle Name	Latitude (ddmmss)	Longitude (ddmmss)	Total Depth (ft)	Section
35-04640	Cumberland	Maurice River Twp	Port Elizabeth, NJ	391518	745355	600	C-C', F-F'
35-04903	Atlantic	Estell Manor City	Tuckahoe, NJ	391946	745125	600	D-D', F-F'
35-09239	Cape May	Middle Twp	Rio Grande, NJ	390422	745447	783	F-F'
35-12081	Cape May	Dennis Twp	Woodbine, NJ	391440	745132	335	C-C'
35-12745	Cape May	Dennis Twp	Heislerville, NJ	391318	745307	300	F-F'
35-25238	Cape May	Middle Twp	Stone Harbor, NJ	390616	744854	715	B-B', E-E'
35-25747	Cape May	Middle Twp	Rio Grande, NJ	390637	745239	755	B-B', F-F'
36-07568	Cape May	Upper Twp	Tuckahoe, NJ	391713	744513	154	D-D'
36-09846	Cape May	Avalon Boro	Avalon, NJ	390629	744253	986	G-G'
36-10378	Cape May	Sea Isle City	Sea Isle City, NJ	390748	744244	916	G-G'
36-13154	Cape May	Upper Twp	Sea Isle City, NJ	391150	743926	870	G-G'
36-16092	Cape May	Dennis Twp	Woodbine, NJ	391225	744551	283	C-C'
36-20238	Cape May	Sea Isle City	Sea Isle City, NJ	390925	744133	905	G-G'
36-23364	Cape May	Dennis Twp	Sea Isle City, NJ	391043	744331	1575	C-C', E-E'
36-28902	Cape May	Sea Isle City	Sea Isle City, NJ	390848	744158	840+	C-C', G-G'
36-30023	Cape May	Upper Twp	Marmora, NJ	391717	743805	750	E-E'
36-31058	Cape May	Upper Twp	Marmora, NJ	391540	743913	743	D-D', E-E'
37-00214	Cape May	Middle Twp	Stone Harbor, NJ	390401	744706	600	B-B'
37-00223	Cape May	Lower Twp	Cape May, NJ	385727	745647	6407	E-E'
37-00233	Cape May	Middle Twp	Stone Harbor, NJ	390219	744711	940	G-G'
37-00236	Cape May	Middle Twp	Stone Harbor, NJ	390525	744851	807	B-B', E-E'
37-00249	Cape May	Middle Twp	Stone Harbor, NJ	390608	745002	258	B-B'
37-00280	Cape May	Avalon Boro	Avalon, NJ	390420	744436	905	G-G'
37-00312	Cape May	Stone Harbor Boro	Stone Harbor, NJ	390350	744505	910	B-B', G-G'
37-00319	Cape May	Wildwood Crest Boro	Wildwood, NJ	385826	745022	402	G-G'
37-01340	Cape May	Upper Twp	Marmora, NJ	391621	744355	740	D-D'
37-03035	Cape May	Middle Twp	Stone Harbor, NJ	390337	744623	380	B-B'
37-03628	Cape May	Lower Twp	Wildwood, NJ	385709	745128	903	G-G'
37-04660	Cape May	North Wildwood City	Stone Harbor, NJ	390012	744720	1000	G-G'
37-05378	Cape May	Cape May City	Cape May, NJ	385652	745300	1500	G-G'
37-05559	Cape May	Lower Twp	Rio Grande, NJ	390220	745607	598	A-A', F-F'
37-06314	Cape May	Lower Twp	Cape May, NJ	385643	745532	875	G-G'
37-06564	Cape May	Cape May City	Cape May, NJ	385713	745727	775	F-F'
37-07592	Cape May	Middle Twp	Stone Harbor, NJ	390043	745158	592	A-A'
37-07593	Cape May	Middle Twp	Rio Grande, NJ	390146	745341	685	A-A'
37-07594	Cape May	Middle Twp	Rio Grande, NJ	390127	745341	688	A-A', E-E'
52-00047	Cape May	Cape May Point Boro	Cape May, NJ	385557	745738	602	E-E', G-G'
57-00036	Cape May	Wildwood City	Wildwood, NJ	385934	744854	665	A-A', G-G'
57-00040	Cape May	Wildwood City	Wildwood, NJ	385940	744900	1244	A-A'
57-00043	Cape May	Lower Twp	Rio Grande, NJ	390002	745410	971	E-E'
57-00044	Cape May	Middle Twp	Rio Grande, NJ	390215	745440	235	A-A'
57-00049	Cape May	Middle Twp	Rio Grande, NJ	390301	745539	200	F-F'
E201215463	Cape May	Lower Twp	Rio Grande, NJ	390122	745642	230	F-F'
E201300367	Cape May	Lower Twp	Cape May, NJ	385947	745722	270	F-F'
E201300369	Cape May	Lower Twp	Rio Grande, NJ	390127	745533	245	A-A'
E201301310	Cape May	Lower Twp	Rio Grande, NJ	390051	745659	260	F-F'
E201417032	Cape May	Middle Twp	Rio Grande, NJ	390227	745534	200	A-A'

Table 2. Summary of aquifer tests in Cape May County on file at the New Jersey Geological and Water Survey. File numbers identifies a particular aquifer test in the NJGWS paper files and in the hydro database. Aquifer designation is the name of the aquifer in which the test well is completed. Aquifer properties are values obtained from or used in the analysis of the time-drawdown data: T is transmissivity in ft^2/day; S is storativity (dimensionless); L is leakance in day $^{-1}$.

File Number	Well Permit No.	Aquifer	Aquifer Properties
12	36-12682	Cohansey	T=12,771 ft^2/day, S=8.489e-4, L=4.123e-3 (L calculated based on r/b value of 0.1.)
102	36-31058	Atlantic City 800' foot sand	T=10,245 ft^2/day, S=3.25e-4, L=6.6e-5
105	35-12231	Holly Beach water bearing zone	T=1,312 ft^2/day, S=4.26e-4, L=6.5e-3/day
177	37-01613	Cohansey	T= 6,398 ft^2/day, S=2.42e-4 - 5.82e-4
181	37-06314	Atlantic City 800' foot sand	T=2,276 ft^2/day, S=3.656e-4, L=1.076e-5/day
233	36-23696	Atlantic City 800' foot sand	T=1,610-1,792 ft^2/day
336	36-31946	Atlantic City 800' foot sand	T=7,906 ft^2/day, S=2.792e-4, L=5.384e-5
337	36-31643	Atlantic City 800' foot sand	T=7,588 ft^2/day
341	P201100104	Cohansey	T=4,752.96 ft^2/day, S=3.869e-4,L=1.147e-4/day
346	37-09846	Atlantic City 800' foot sand	T= 7,437 ft^2/day, S=6.619e-4
367	37-00240	Atlantic City 800' foot sand	T=6,515 ft^2/day, S=3.331e-4, L=5.405e-5/day
379	37-00403	Cohansey	T=3,121.6 ft^2/day, S=1.771e-4, L=3.59e-6/day



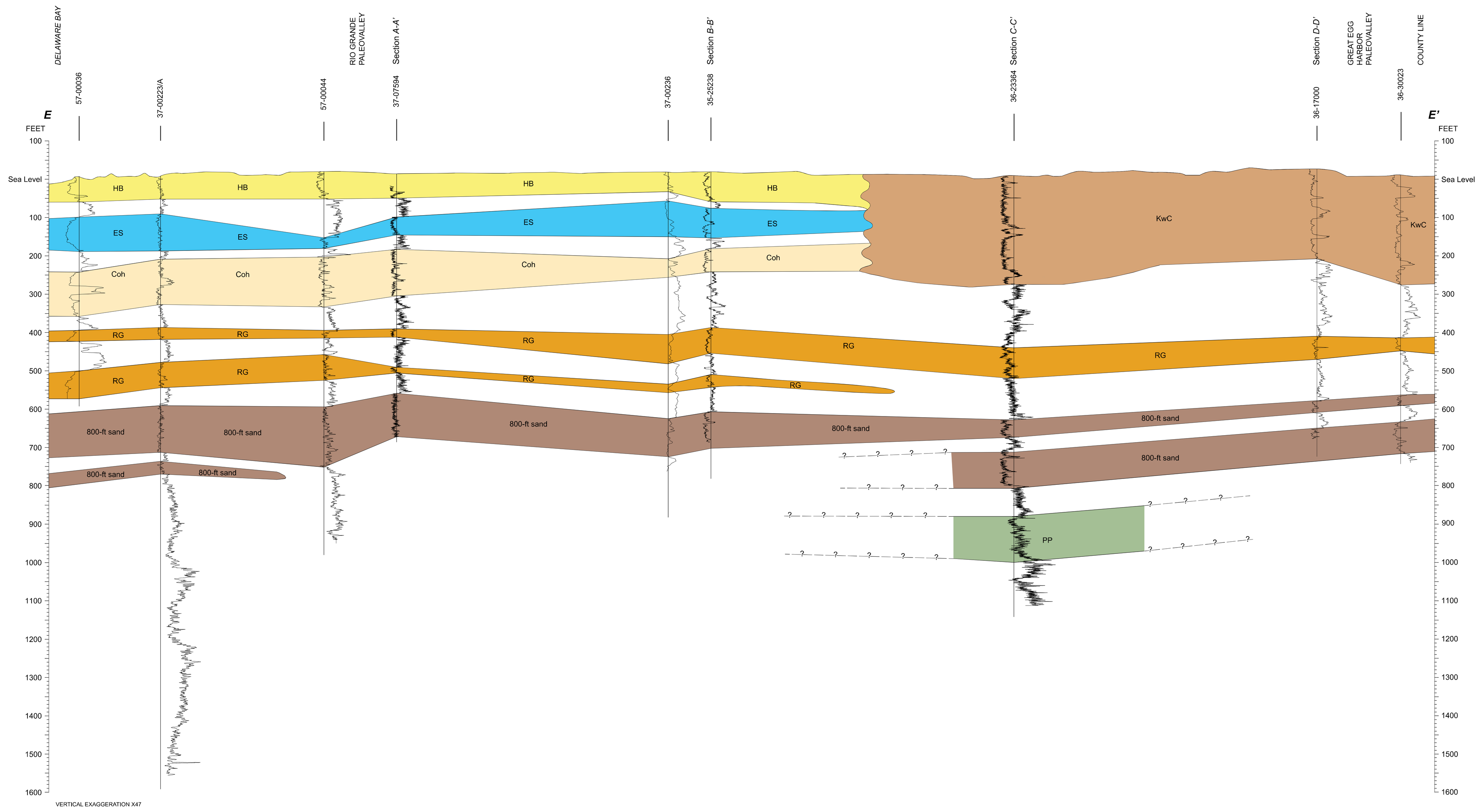


Figure 16. Hydrogeologic section E-E'

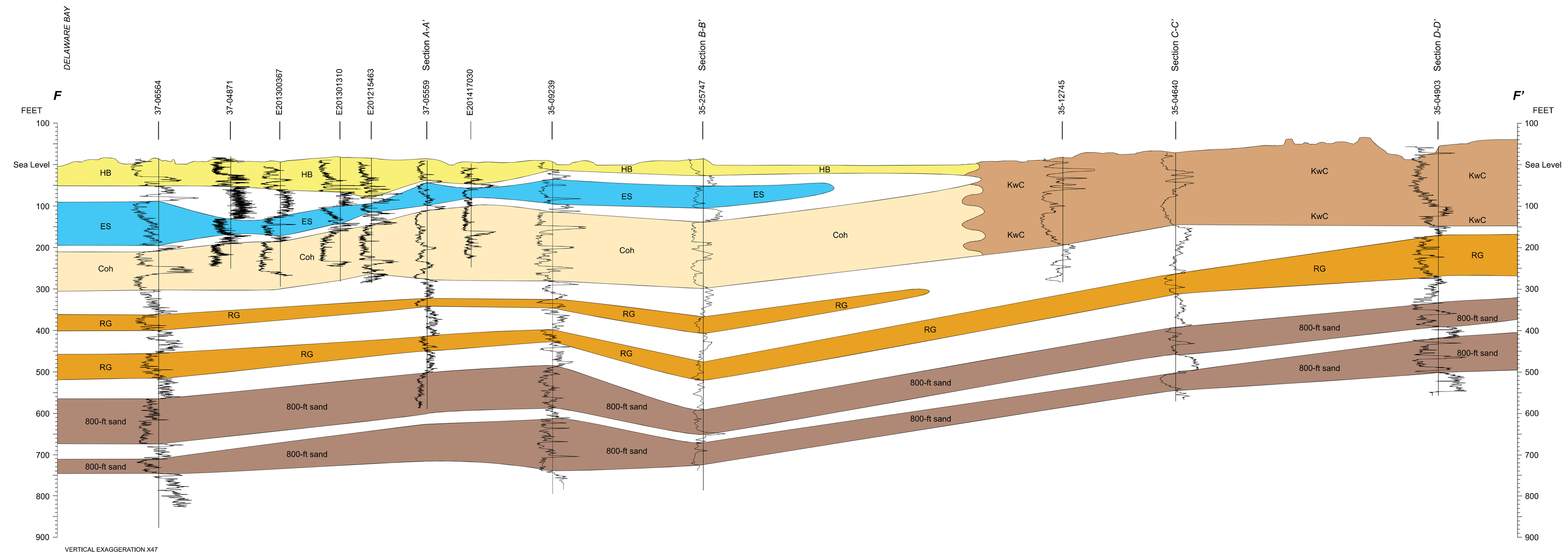


Figure 17. Hydrogeologic section F-F'

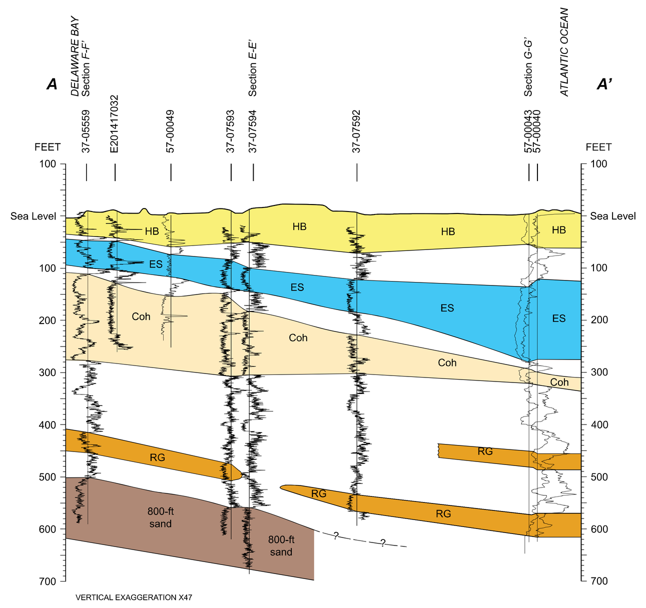


Figure 12. Hydrogeologic section A-A'

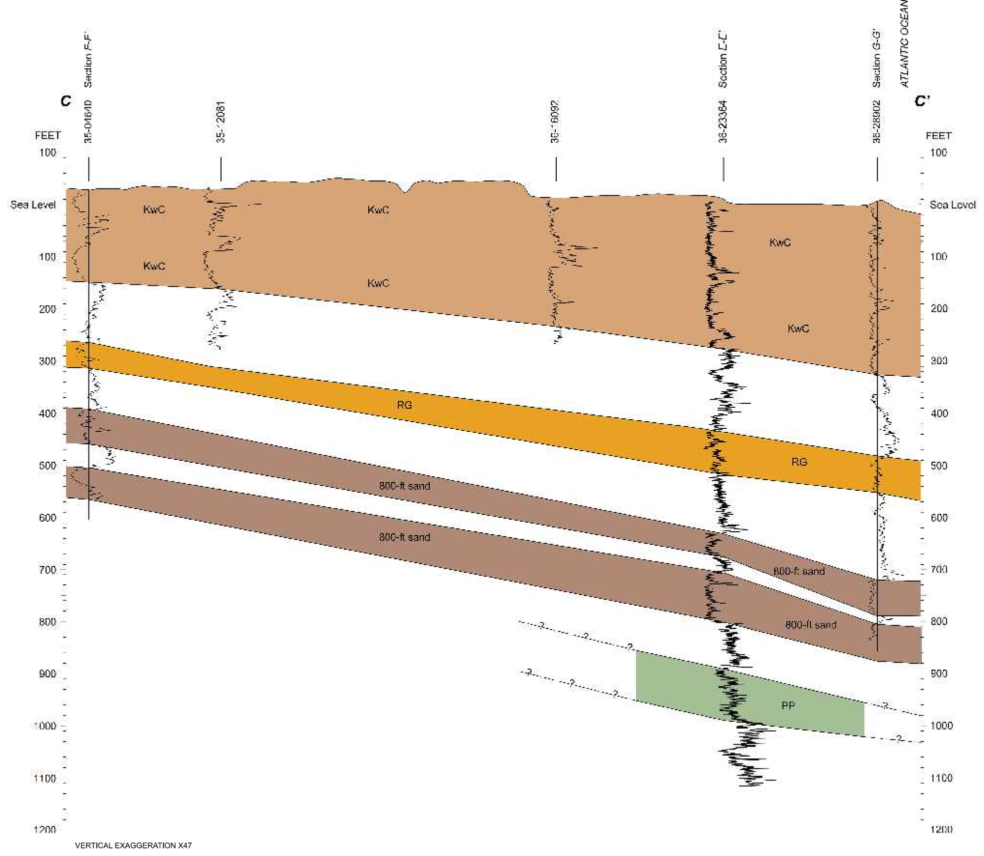


Figure 14. Hydrogeologic section C-C'

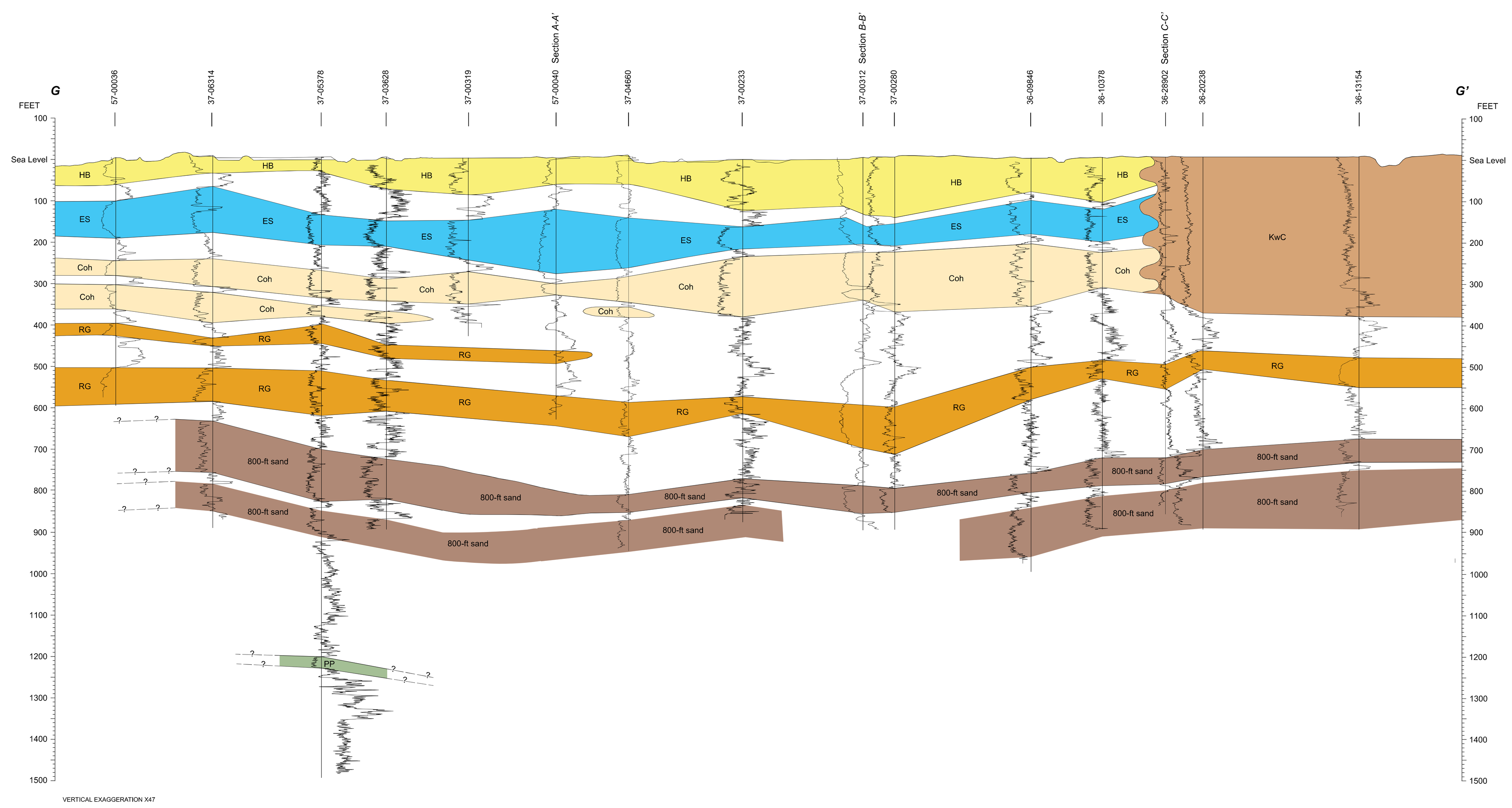


Figure 18. Hydrogeologic section A-A'

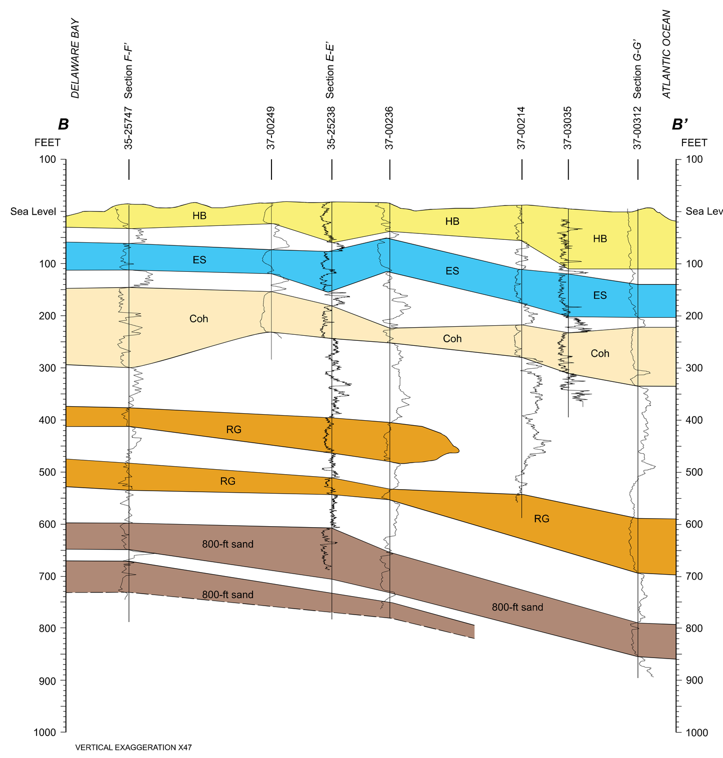


Figure 13. Hydrogeologic section B-B'

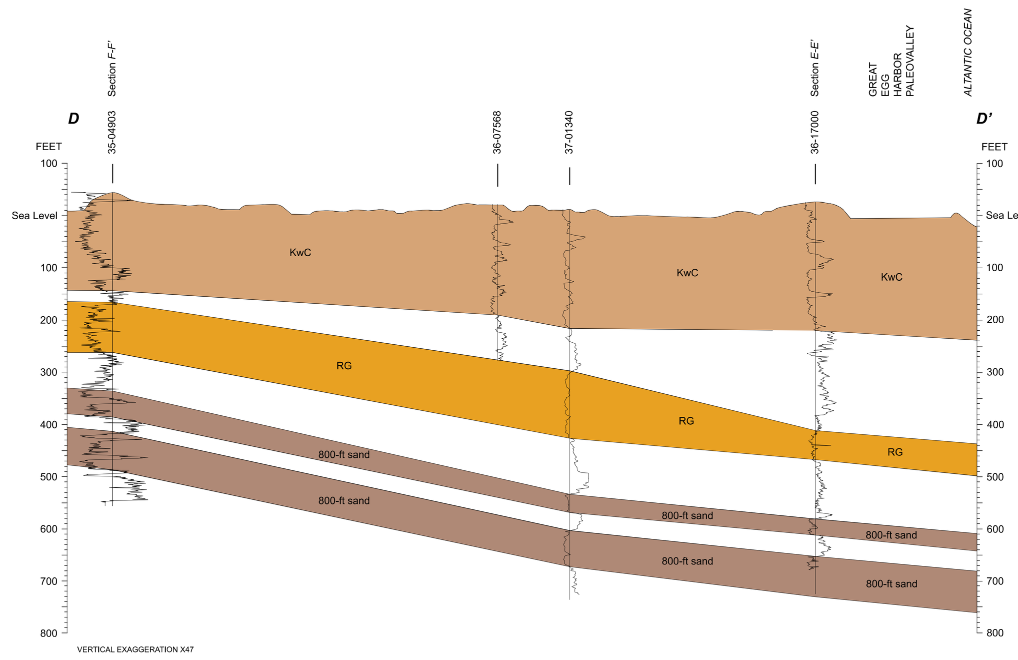


Figure 15. Hydrogeologic section D-D'

Geologic and Aquifer Map of Cape May County, New Jersey

by

Peter J. Sugarman, Donald H. Monteverde, Scott D. Stanford,
Stephen W. Johnson, Yelena Stroiteleva, Ronald S. Pristas,
Kathleen Vandegrift, and Steven E. Domber

2016

Digital compilation by R.S. Pristas.
Cartography by R.S. Pristas and D.H. Monteverde.

APPENDIX F

Wetlands Map

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U.S. Fish and Wildlife Service

National Wetlands Inventory

Wetlands Map for Former NAS Cape May

October 16, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

National Wetlands Inventory (NWI)
This page was produced by the NWI mapper

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APPENDIX G

Locations of Potential Monitoring Wells

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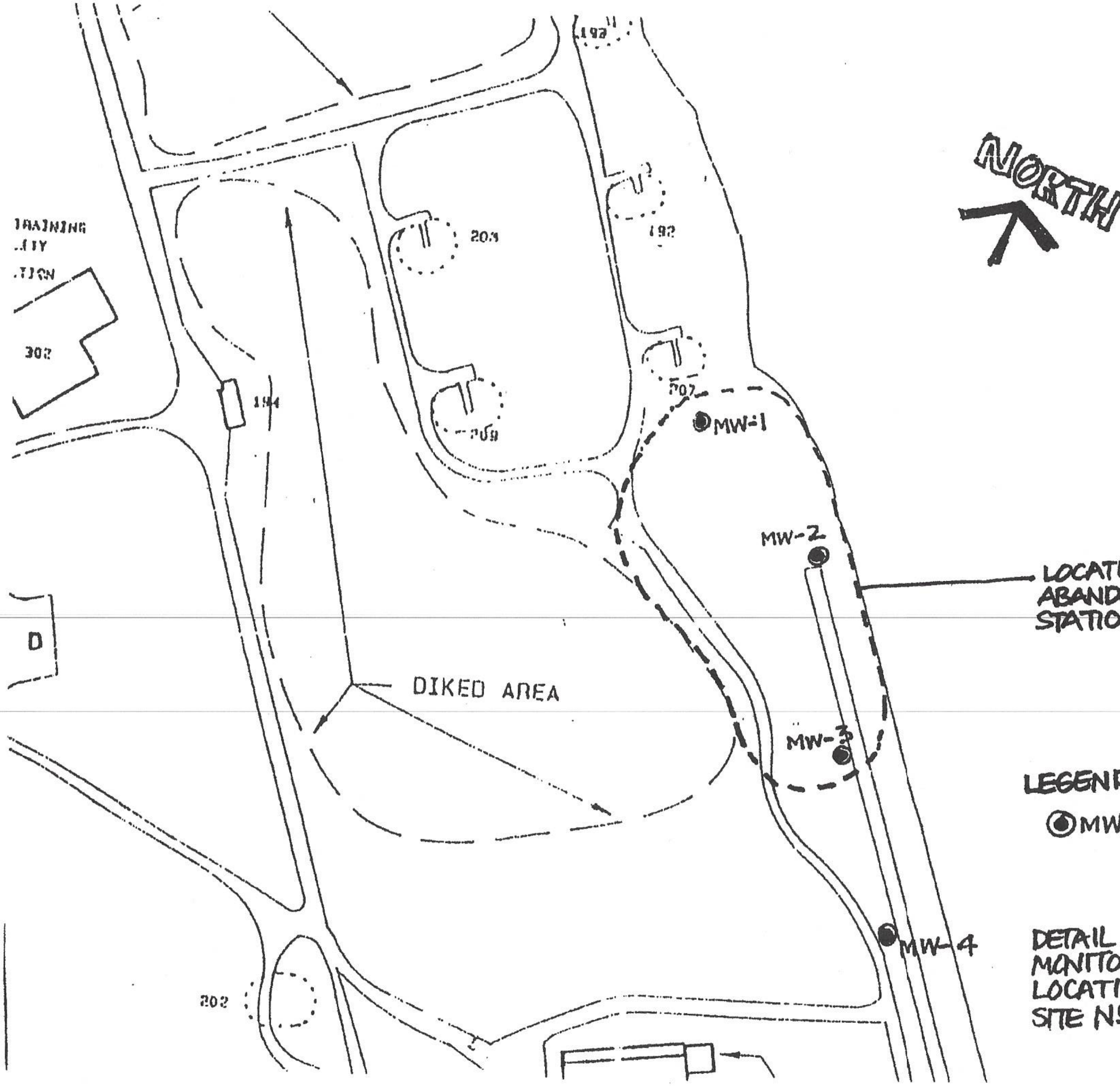
FIGURE 1



DETAIL SITE MAP OF MONITORING WELLS LOCATION
SITE Nº. C02NJ0951

Encl 1

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