US Army Corps of Engineers

FUSRAP

FINAL PROPOSED PLAN
GROUNDWATER OPERABLE UNIT OU2

MIDDLESEX SAMPLING PLANT FUSRAP SITE
MIDDLESEX, NEW JERSEY

AUGUST 2020

PREPARED BY:

U.S. ARMY CORPS OF ENGINEERS
FORMERLY UTILIZED SITES REMEDIAL ACTION PROGRAM

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List of Abbreviations and Acronyms

ARAR	Applicable or Relevant and Appropriate Requirement
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	chemical of concern
CT	carbon tetrachloride
DOH	Middlesex Department of Health
FFA	Federal Facility Agreement
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
HHRA	Human Health Risk Assessment
ISCR	in situ chemical reduction
LUC	land use control
MCL	maximum contaminant level
µg/L	micrograms per liter
MED	Manhattan Engineer District
MNA	monitored natural attenuation
MSP	Middlesex Sampling Plant
MTBE	methyl tert-butyl ether
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NJDEP	New Jersey Department of Environmental Protection
OU	operable unit
PRAR	Post Remedial Action Report
RAO	remedial action objective
RI	Remedial Investigation
SLERA	Screening Level Ecological Risk Assessment
TCE	trichloroethene
USACE	U.S. Army Corps of Engineers, North Atlantic Division, New York District

List of Abbreviations and Acronyms (cont.)

USAEC	U.S. Atomic Energy Commission
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

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1 Introduction

The U.S. Army Corps of Engineers, North Atlantic Division, New York District (USACE) is issuing this Proposed Plan as part of its public participation responsibilities under 40 C.F.R Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The USACE conducted remedial investigations (RIs) at the Middlesex Sampling Plant (MSP) site in Middlesex, New Jersey (see Figure 1-1). The remedial effort at the site addressed soil, sediment, surface water, and groundwater impacted by radioactive and/or chemical materials. Remedial investigations of soil and groundwater at the MSP site were addressed under two operable units (OU1/soil and contaminated debris, and OU2/groundwater, surface water, and sediment) by the USACE from 1999 through 2016. Remedial action for OU1 at the MSP site was completed in 2008. The remedial action for OU1 included excavation of soil and debris contaminated with radioactive and chemical waste above the criteria for residential use of the site. The excavated material was subsequently transported and disposed off-site at an approved licensed or permitted facility. This Proposed Plan addresses remedial action for OU2 at the MSP site. Based on the findings presented in the previous groundwater investigation reports and the results of the risk assessments completed for the MSP site, the surface water and sediment do not pose unacceptable risks. Therefore, surface water and sediments do not require further evaluation in this Proposed Plan and only groundwater will be evaluated.

The MSP site was formerly part of the nation's early atomic energy program. It is no longer operational and was placed on the U.S. Environmental Protection Agency (USEPA) National Priorities List in 1999 under the Federal Facilities program (USEPA ID No. NJ0890090012). The USACE was delegated the authority to clean up the site under the Formerly Utilized Sites Remedial Action Program (FUSRAP) by the Energy and Water Development Appropriations Act of 1998, and subsequent reauthorizations of the act. The USACE is the lead agency for the site CERCLA response activities described below and USEPA Region II is the lead regulatory agency for oversight activities. In September 2009, the USEPA, USACE, and the U.S. Department of Energy (USDOE) entered into a Federal Facility Agreement (FFA) for MSP, which delineated roles and responsibilities for the three agencies.

Public input on the preferred remedy and on the other remedial alternatives presented in this Proposed Plan is requested. The USACE will hold a virtual public meeting to explain the proposed final remedy and receive public comments (see Section 9). The USACE will also accept written comments on the Proposed Plan during a 30-day public comment period from 24 August 2020 through 25 September 2020. The online/virtual public meeting will be held on 31 August 2020, starting at 6 pm.

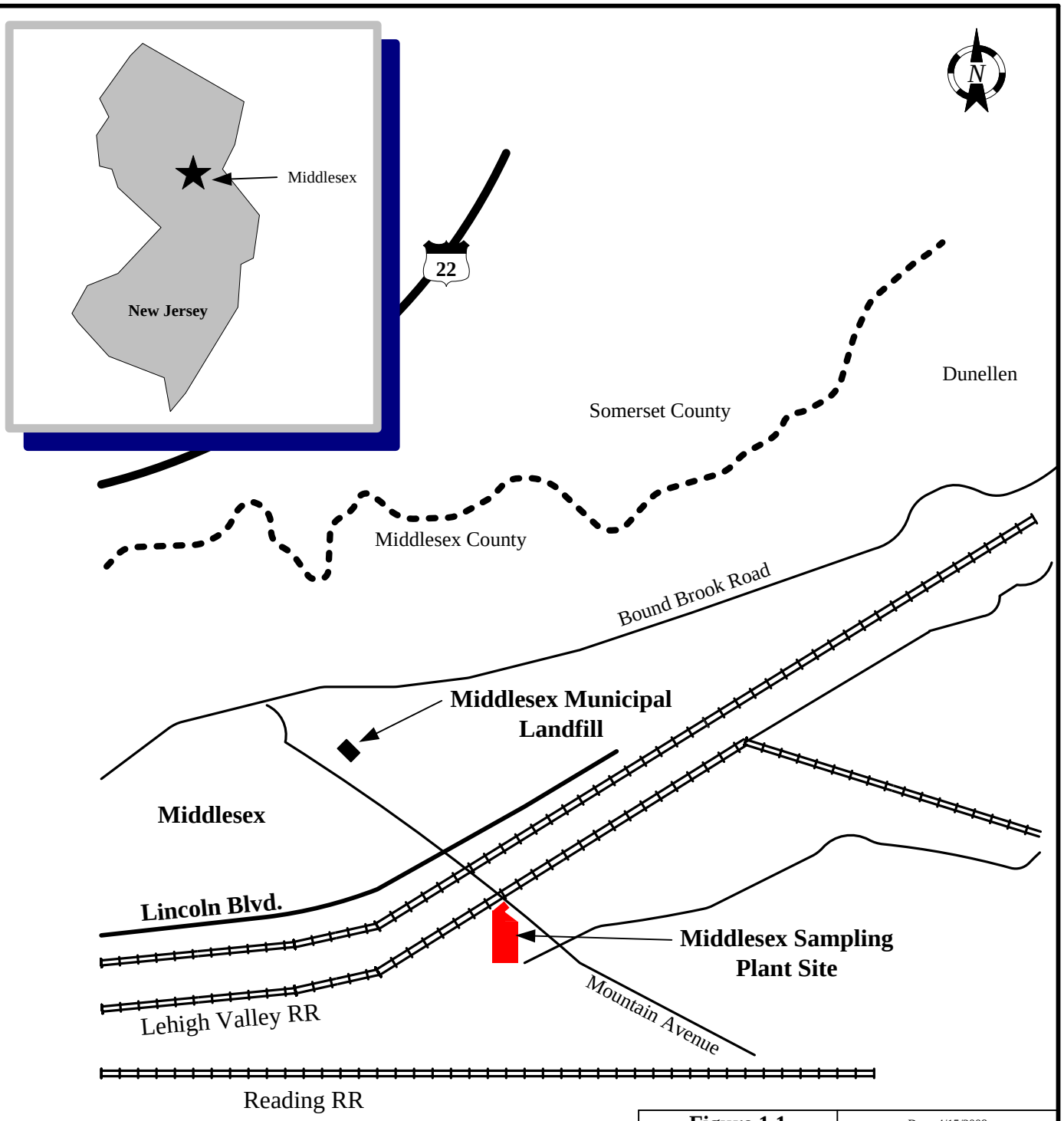
1.1 Purpose of the Proposed Plan

The purpose of this Proposed Plan is to (1) describe the remedial alternatives considered for contaminated groundwater for OU2 at the MSP site, (2) identify the preferred remedial action, (3) present the rationale for the preference, and (4) invite public input to ensure that the remedy selected for groundwater at the MSP site addresses the concerns and meets the needs of the local community.

The site characteristics and remedial alternatives summarized in this Proposed Plan are described in the following reports:

- The extent of groundwater contamination in the OU2 groundwater is documented in the *Groundwater Operable Unit Remedial Investigation Report, Middlesex Sampling Plant, Middlesex, NJ, May 2005*, and the *Groundwater Investigation Technical Memorandum, Middlesex Sampling Plant, Middlesex, NJ, August 2017*; and
- The Groundwater OU2 remedial action alternatives were evaluated in the *Feasibility Study Report, Groundwater Operable Unit, Middlesex Sampling Plant FUSRAP Site, Middlesex, NJ, October 2017*.

The nature and extent of groundwater contamination at the site and emanating from the site was determined during the RI and additional groundwater investigations. The FS identifies and evaluates remedial alternatives to address the contamination. The RI/FS reports and other related information that have been generated as part of this CERCLA response action are contained in the Administrative Record for the site and are available for review at the Middlesex Public Library (see Section 9 for details). This Proposed Plan is provided as a supplement to the RI and FS reports to inform the public of the preferred groundwater remedy.



Legend

- County Boundary
- Creeks
- Roads
- Railroads

Not to Scale

Figure 1.1	Date: 4/15/2008
Drawn By: ROW	Checked By: DMM

Middlesex Sampling Plant
Middlesex, New Jersey

Site Location Map

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The contaminants identified in the groundwater as chemicals of concern (COCs) at the MSP site are volatile organic compounds (VOCs) consisting of carbon tetrachloride (CT), trichloroethene (TCE), and chloroform in bedrock groundwater; and uranium in the overburden groundwater. Concentrations of uranium in groundwater were significantly reduced after soil impacted with uranium and other radionuclides was removed from MSP during the OU1 remedial action in 2008. Although uranium concentrations in the overburden groundwater have not exceeded the USEPA maximum contaminant level (MCL) for drinking water since 2012, uranium in groundwater will continue to be monitored.

To address the contaminated groundwater, the USACE preferred remedy consists of land use controls (for example, well restrictions in a groundwater Classification Exception Area [CEA]), groundwater monitoring, monitored natural attenuation (MNA) for VOCs and uranium, and in situ treatment of VOCs onsite in the source area at the MSP. The groundwater monitoring portion of the remedy will include documenting the natural degradation of chemicals in the groundwater (called natural attenuation parameter analyses) and monitoring the change in aquifer conditions including chemical concentrations. Under this remedy, contaminated groundwater would be treated by injecting substances that cause the chemical reduction (breaking of chemical bonds) of the VOCs. The remedy will be considered complete once groundwater contamination above cleanup levels is removed on the MSP site in both onsite and offsite wells. This has been selected as the preferred remedy because it is protective of human health and the environment and cost effective. Additional detail of the evaluation process is provided throughout this Proposed Plan.

Some of the key elements included in the preferred remedy are discussed below.

Groundwater Classification Exception Area (CEA). The New Jersey Department of Environmental Protection divides groundwater into classes based on groundwater use. Each class has its own chemical, physical, and biological standards. When a local groundwater area does not meet the standards, but is being monitored or treated, the State can issue an exception to the classification. The exception provides notice that there is groundwater pollution in a localized area and suspends all designated groundwater use in each CEA during the life of the CEA.

In-Situ Treatment. In-situ treatment involves injection, through permanent or temporary wells, of selected chemicals into the subsurface to treat groundwater contamination. These chemicals are selected based on laboratory and field studies of the treatment process and knowledge of the expected results. The chemicals selected are based on the type of contamination present in the subsurface, chemical and mineral composition of the aquifer, and rate of the desired chemical reactions. In-situ treatment methods destroy or convert groundwater contaminants to less toxic compounds in the subsurface.

Natural Attenuation. Natural attenuation relies on natural processes to clean up or attenuate contamination in groundwater. When water is contaminated with chemicals, nature can work in the following four ways to clean it up: (1) microorganisms (e.g., naturally occurring bacteria) that live in soil and groundwater can use the chemicals for food or respiration, which changes the chemicals into harmless substances, (2) chemicals can stick or adsorb to soil, which holds them in place and keeps them from polluting groundwater, (3) the chemicals can mix with clean water, which reduces the concentration via dilution, and (4) chemicals can react with natural substances underground which can convert contaminants into less harmful forms.

1.2 Scope and Role of Preferred Remedial Alternative

The primary objectives of the preferred remedial action are to minimize any potential future health and environmental impacts due to current or future exposure to COCs in groundwater and to comply with Applicable or Relevant and Appropriate Requirements (ARARs). The preferred remedial action is proposed to include groundwater use restrictions, such as well restrictions in a CEA; in situ treatment of the VOCs source found in fractured bedrock; and a long-term groundwater monitoring program to document natural environmental processes reducing the remaining contamination (any residual uranium in the overburden and off-site VOCs) to concentrations below cleanup levels.

There are two OUs (OU1 and OU2) for the MSP site. The remedial action for OU1 for soils was completed in 2008 and included excavation of soil and debris contaminated with radioactive and chemical waste above the criteria for residential use of the site. The remedial action for OU2 addresses groundwater contaminated with FUSRAP waste at MSP under CERCLA.

1.3 Public Participation

Public input on the preferred remedy and on the other alternatives presented in this Proposed Plan is requested. After the public comment period has ended, the USACE and USEPA, in coordination with the New Jersey Department of Environmental Protection (NJDEP), will select a final OU2 remedy for the groundwater at the MSP site, taking into consideration the comments received during the public comment period. The agencies may select the preferred remedy or any of the other alternatives presented in this Proposed Plan. Consequently, the public is encouraged to review and comment on all of the alternatives described herein, not just the preferred remedy. Additional information on the public comment period is presented in Section 9 of this Proposed Plan.

2 Site Background

2.1 Site Description

The MSP property is approximately 9.6 acres and is located at 239 Mountain Avenue in the Borough of Middlesex, New Jersey (see Figure 1-1). It is located approximately 40 miles southwest of New York City and 24 miles southwest of Newark, New Jersey. The population of New Jersey as estimated by the U.S. Census Bureau on July 1, 2016, is 8,944,469; 837,073 people reside in Middlesex County. The forecasted population growth rate for Middlesex County is 0.2 percent annually over the 2001 to 2026 period (County of Middlesex 2003). The population of Middlesex County has steadily increased over the past 30 years with an overall growth of approximately 21 percent. The area within a half-mile of the MSP site is a mixture of residential homes, commercial and industrial properties, and undeveloped land. The MSP site is bordered to the east by residential and commercial properties, to the south by condominiums followed by residential property, to the west by a scrap metal facility followed by a commercial property, and to the north by a railroad right-of way followed by residential property. The MSP site is zoned Industrial by the Borough of Middlesex Planning Commission. The MSP site is currently vacant land with grass cover and includes a gravel access road on the east side of the property. It is also fenced and public access is restricted.

Site topography is relatively flat with surface elevations ranging from approximately 58 feet above mean sea level at the north end to 49 feet above mean sea level along the south end. Storm water flows over the site surface as sheet flow to the south and is collected and discharged off site into the South Drainage Ditch. The property to the south consists of a marshy land and fields. South Drainage Ditch carries surface water runoff from the site into Main Stream and is approximately 1,150 feet long. The Main Stream flows intermittently in a southwesterly direction for approximately 2,100 feet where it flows through wetlands (Palustrine Forested and Palustrine Scrub/Shrub) prior to discharging into Ambrose Brook (see Figure 2-1).

2.2 Site History

The MSP site was originally developed in 1910 (original company unknown) as an industrial plant for the manufacturing of asphalt paint. This plant included a brick warehouse, boiler house, garage, administration building, dye warehouse, and four smaller buildings. In 1913, American Marietta Company, who sold

products under the name American Asphalt Company, purchased the original company that began operations on the site.

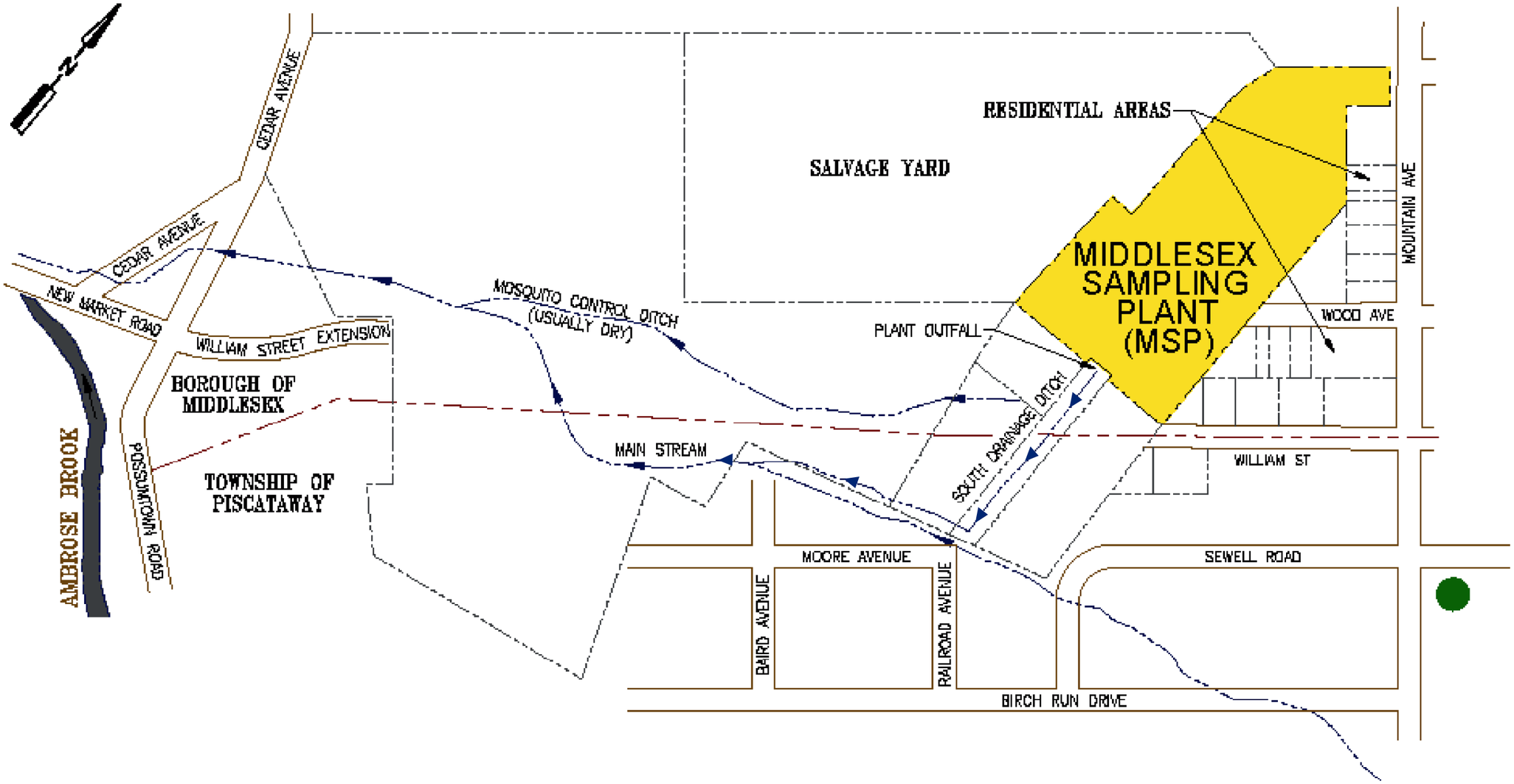
During October 1943, the Manhattan Engineer District (MED) leased the brick warehouse from the American Marietta Corporation and converted it into a process building to sample, store, test, and transfer ores containing uranium, thorium, and beryllium. Between 1943 and 1955, analysis of ores for uranium was the primary operation conducted at MSP by United Lead Company, which was a subcontractor of the MED/U.S. Atomic Energy Commission (USAEC). Uranium ores were received in burlap bags that were stacked and stored on the ground. The ore was thawed (if necessary), dried, crushed, screened, and collected in hoppers, the contents of which were then sampled for analysis. Ores were then packaged, weighed, and shipped to processing facilities.

In 1946, MED was deactivated and MSP operations were continued under the direction of the USAEC, which acquired the leased facility by condemnation. During this period, various new buildings were constructed, including replacements for the administration building and garage, a thaw house, and a storage house. A chain-link fence was installed to surround the site, and most of the property was paved with asphalt for use as a drum storage area.

Throughout the late 1940s and early 1950s, MSP received and shipped various research and decontamination wastes and incinerated low-level combustible waste at the site. The incinerated ashes and noncombustible scrap were allegedly placed in drums and transported off site for disposal.

During 1951 and 1952, the MSP became an intermediate point for shipment of uranium bars to a location where the bars were experimentally machined into slugs. Scraps from this operation were then returned to the MSP for shipment to a uranium recovery processor. Over the years that the MSP was operational, the site buildings, soils, and groundwater, as well as nearby land parcels, became contaminated with radium and uranium. The handling of uranium ore sacks likely resulted in spillage, and subsequent migration mechanisms such as precipitation, runoff, and infiltration, caused localized radiological contamination both on and off site.

The USAEC ceased primary operations at the MSP site in 1955. However, the site continued to be used for storage and limited sampling of thorium residues. All USAEC activities at the site were terminated in September 1967 after decontamination of the structures and certification of the site for unrestricted release was complete. In 1968, the USAEC returned the MSP property to the General Services Administration, which then transferred the property to the U.S. Department of the Navy. The site served as a U.S. Marine Corps reserve training center from 1969 to 1979, before it was placed back in the custody of the USDOE in 1980. The site, no longer operational, is addressed as a USACE FUSRAP site.



LEGEND:

- TOWN BOUNDARY
- SITE BOUNDARY
- PARCEL BOUNDARY
- ROAD RIGHT OF WAY
- CREEK OR STREAM
- DITCH LINE
- PARK LOCATION

GRAPHIC SCALE

400' 0 200' 400'

REFERENCES:

1.) BNI, DRAWING NO. R99F001.DGN

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Middlesex Sampling Plant
Middlesex, New Jersey

Figure 2-1
Vicinity Map

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The USAEC, a predecessor to the USDOE, established FUSRAP in 1974 to identify, remediate, or otherwise control sites contaminated with residual radioactivity resulting from activities of the MED and early operations of the USAEC. The goal of FUSRAP is remediation of sites contaminated as a result of the nation's early atomic energy program in accordance with CERCLA, as amended. Responsibility for execution of response actions on sites included in FUSRAP was transferred from the USDOE to USACE by Public Law 105-62, October 13, 1997, and long-term programmatic authority was specifically provided to USACE in Public Law 106-60, Section 611, on September 29, 1999. This authorizes the USACE to conduct remediation of sites contaminated as a result of the nation's early atomic energy program. On February 18, 1999, the MSP site was added to the National Priorities List in the Federal Facilities Section. Furthermore, Public Laws 105-245 and 106-60 clarified Congressional intent that response actions taken by the USACE under FUSRAP should be performed subject to the provisions of CERCLA and the NCP. Under CERCLA, National Priorities List sites must undergo a detailed two-part study called an RI/FS. The RI describes the nature and extent of contamination, its fate and transport, and its impact on baseline risk assessments. That information is then used in the FS to evaluate remedial action alternatives. The history of the investigations used to generate the RI/FS are included in Section 2.4.

2.3 Hydrogeologic Setting

Fractured shale, siltstone, and sandstone bedrock underlie the site and are referred to as the Passaic Formation. Groundwater contained within the fractures of this bedrock makes up the aquifer (Brunswick Aquifer) and is the major aquifer of the region located throughout a large part of central and northeastern New Jersey. Regionally, the top of aquifer can be as shallow as 20 feet below existing grade and extend to depths up to 1,500 feet below existing grade. It is used for domestic, municipal, and industrial water supply. The common well yield rate of the aquifer is 10 to 500 gallons per minute. Well yields have been known to exceed 1,500 gallons per minute. Water, generally hard, may have high concentrations of iron and sulfate (U.S. Geological Survey 1999).

The aquifer has been described as consisting of a series of alternating units (discrete zones of groundwater flow) and aquitards over several tens of feet thick. An aquitard is any geologic layer that slows the movement of groundwater but does not block it. Water-bearing fractures of each aquifer unit are more or less continuous, but groundwater connectivity between individual units has been described as poor. These aquifer units tilt downward along with the direction of the bedrock layers.

Above the bedrock aquifer, groundwater can be found closer to the surface within the overburden material (weathered bedrock at the surface) that lies on top of bedrock. This groundwater is typically a thin lens of water (several feet) accumulated from precipitation on top of the bedrock and slowly infiltrates into the bedrock aquifer. It is typically found at depths less than 15 feet below ground surface. This overburden groundwater unit typically does not provide an

economical source of groundwater because of low yield and availability that fluctuates with precipitation amounts.

Site Specific Hydrogeology

Water closest to the surface at the MSP site resides in the overburden water unit and can be found between 2 feet and 8 feet below ground surface depending on location and amount of precipitation. This water-bearing unit is perched on top of the bedrock, at the interface with overburden (weathered bedrock), and is up to several feet thick. Groundwater flows radially (outward) away from a central location on the northern part of the site.

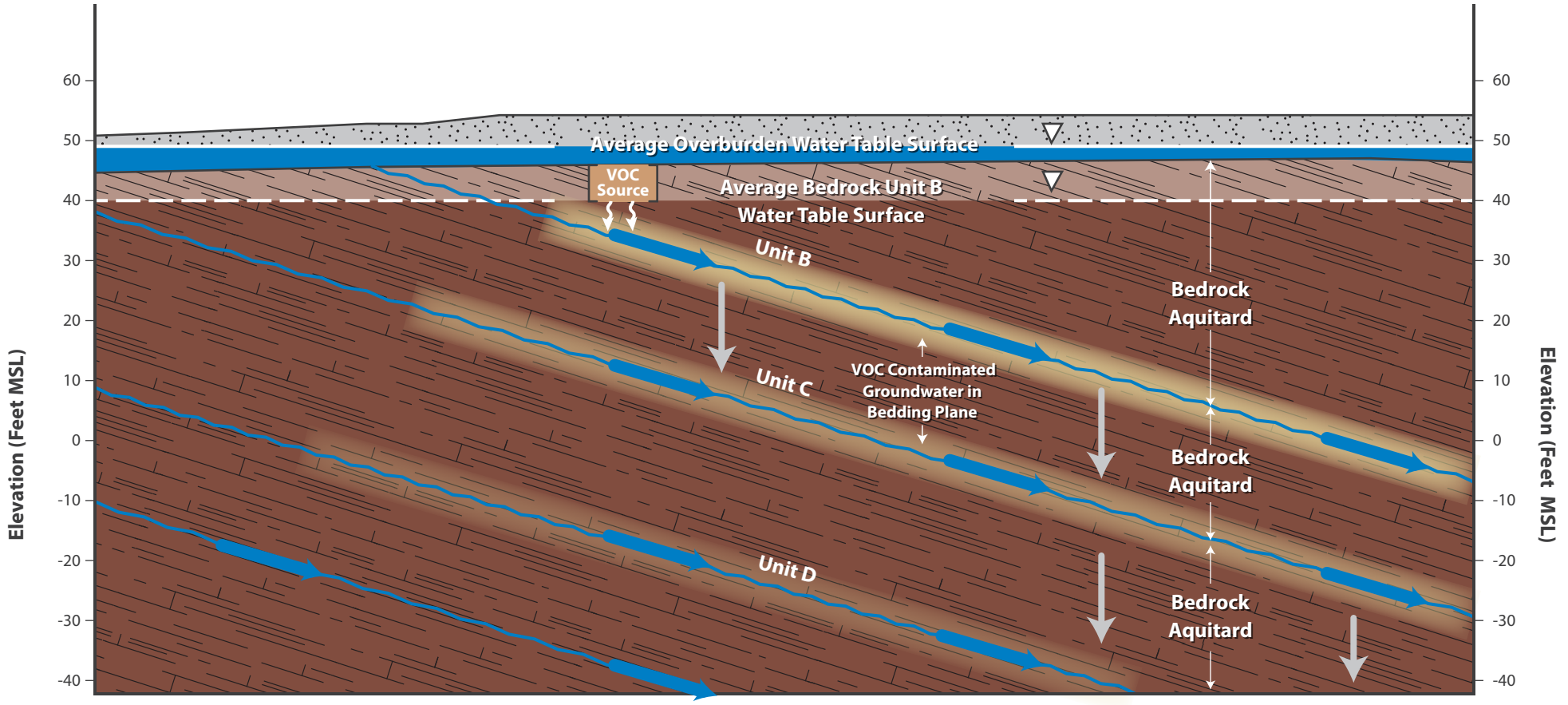
The bedrock at the MSP site is defined as a leaky, multi-unit aquifer system of the Brunswick Aquifer (USACE 2017a). Studies completed on the local bedrock aquifer using geophysical testing, discrete groundwater sampling, pumping tests, and others concluded that three main aquifer units are located across the northern part of the site. These were named Units B, C, and D from shallowest to deepest (see Figure 2-2). These three units were the focus of the groundwater quality study in the bedrock. The top of the groundwater within the bedrock is found between 15 to 24 feet below ground surface at the site. Groundwater flows to the north-northwest in the bedrock and is carried downward along the tilted fractures of the bedrock. Therefore, shallow groundwater at the site moves deeper as it moves away from the site.

Groundwater Supply Wells

The bedrock underlying the site (the Passaic Formation) contains groundwater that is used for domestic, municipal, and industrial water supplies in Middlesex and surrounding counties.

Unless otherwise designated, waters of New Jersey are classified as Class II-A (N.J.A.C.7:9C Groundwater Quality Standards). The primary designated use for Class II-A groundwater is potable water and conversion (through conventional water supply treatment, mixing, or other similar technique) to potable water. Class II-A secondary designated use includes agricultural water and industrial water. The MSP on-site and off-site groundwater is classified as Class II potable groundwater, although the groundwater at the MSP site is not presently used as potable water.

In 2010, the USACE conducted a private potable water well survey to determine the number of registered wells within a half-mile of the MSP site. The USACE used several resources to identify and locate supply wells that may still be in service for providing potable water to residents or local businesses. The on-line NJDEP well search resource was used to identify registered wells within a half-mile of the MSP site, which resulted in the identification of 12 properties with records of existing potable water wells.



LEGEND

- Overburden
- Overburden Groundwater Unit
- Unsaturated Bedrock Zone
- Bedrock (Passaic Formation: Red Siltstone and Shale)
- Bedding Plane
- Bedrock Groundwater Flow Direction
- VOC Contaminated Groundwater in Bedding Plane
- Vertical Fractures

Vertical Exaggeration=1.5X
Approximate Horizontal Scale=
1 inch Equals 45 Feet
MSL=Mean Sea Level

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Middlesex Sampling Plant
Middlesex, New Jersey

Figure 2-2
Site Hydrogeology

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To investigate additional properties within the search area that may exist, but not registered with the state, the USACE consulted with the Middlesex Department of Health (DOH) to request a list of properties with a water well or a record of identified contamination. The DOH did not identify any wells that had not been already identified through the NJDEP search.

In order to provide a more comprehensive assessment, Middlesex, New Jersey tax maps were searched to identify addresses within a half-mile radius of the MSP site that could potentially be impacted by contamination from the MSP site. Over 300 properties were identified. After cross-checking- the address list with the New Jersey-American Water Company to eliminate properties on public water supply, 42 properties could not be verified as being supplied by a public water source and, therefore, those properties potentially relied on groundwater obtained from a potable well. A field reconnaissance, which included door-to-door inquiries or roadside identification of public supply well taps, was completed for each property.

The document search and field reconnaissance resulted in a list of nine properties that were potential candidates for collecting groundwater samples. Groundwater samples were collected from seven properties in the fall of 2010, and no VOCs were detected above the NJDEP drinking water criteria. A sample from another residential property located on William Street was collected in the spring of 2010. Methyl tert-butyl ether (MTBE) was detected in the sample. However, MTBE is not a site COC and there is no MCL. One additional groundwater sample was collected from a potable water well located on Mountain Avenue, adjacent to the MSP site. The analytical test results indicated VOCs concentrations above the NJDEP drinking water criteria; therefore, the property was connected to the City water supply line and the well was converted into a monitoring well.

2.4 History of Remedial Investigations

Previous site investigations and historical results of groundwater contamination at the MSP site is based on the results of the following:

- Historical investigations;
- Soils OU1 RI (2000-2001);
- Groundwater OU2 RI (2000-2004);
- Various reports (from 2000 through 2008); and
- Supplemental bedrock investigation (2008-2016).

Site characterization was previously described in other reports following investigations performed in 1976, 1980, 1983, 1991, and 1996 (referred to as "historical" investigations). Since the quality of the historical results could not be verified, they were not used in defining the nature or extent of site contamination. The historical investigations are summarized in the *Final Feasibility Study Report, Groundwater Operable Unit* (USACE 2017a).

All contaminated site media (i.e., surface and subsurface soils, asphalt pads, and demolition debris) were removed from the MSP site to established cleanup goals per the OU1 Record of Decision for soil (USACE 2005a). The site media were disposed of off-site at an approved, licensed or permitted facility. Excavation and off-site disposal of radiologically and chemically contaminated soil as part of the OU1 remedial action was completed in June 2008. The removal of the contaminated media has resulted in the removal of potential sources that may further impact the groundwater. However, residual levels of groundwater contamination were expected to remain. Following the removal activities, post-remedial action measurements were collected to verify that cleanup goals were attained as documented in the Post Remedial Action Report (PRAR; USACE 2010).

The data from the groundwater investigations were used to define the nature and extent of the groundwater contamination at the MSP site. The following presents a summary of the activities and results for each of these events. These activities were documented in the *Final Feasibility Study Report, Groundwater Operable Unit* (USACE 2017a).

Groundwater OU2 RI

From 2001 through 2005, a groundwater investigation was performed to define the nature and extent of the contamination in the groundwater, surface water, and sediment at the MSP site. In addition, this investigation included an evaluation of the fate and transport of contaminants at the MSP site and assessment of potential human health and ecological risk. The investigation included collecting groundwater samples from overburden and bedrock monitoring wells. Sediment and surface water samples were collected from the South Drainage Ditch, Main Stream, and Mosquito Control Ditch. The samples were analyzed for VOCs, semivolatile organic compounds, metals, and radionuclides. In addition, two background groundwater monitoring wells were installed off site and sampled. In November 2004, a supplemental off-site delineation investigation was performed, which included installing and sampling temporary well points, piezometers, and monitoring well clusters. Based on the findings presented in the groundwater RI report and the results of the risk assessments completed for the MSP, the surface water and sediment do not pose unacceptable risks and do not require further evaluation.

Environmental Surveillance

From 2000 to 2008, an environmental surveillance program was established at the MSP site to monitor the effect of site activities on the surrounding environment and public health in order to assess whether both were adequately protected from site contamination. The data collected from the program were originally designed to estimate potential radiation doses to the general public and to a maximally exposed individual from radioactive material at the MSP site. Results from the program indicated that the environmental conditions were consistent with the site background levels. Groundwater, air, surface water, and sediment were sampled prior to the completion of the 2008 OU1 remedial action.

Sampling Events

The environmental surveillance program ended in 2008 and was replaced with groundwater sampling events, which evaluated both the uranium and VOCs detected in groundwater. A total of 13 sampling events were conducted from 2008 to 2012. Uranium exceedances were detected in four wells during nine of the sampling events. VOCs exceedances were detected in several wells during each of the sampling events.

Supplemental Bedrock Groundwater Investigation

The groundwater investigation initially addressed only radioactive groundwater contamination. However, the groundwater data indicated persistent elevated levels of VOCs in two of three bedrock wells (MW-26 and MW-27). These wells are located downgradient of the Process Building (Figure 3-1). After evaluating this data, the USACE determined that installation of additional bedrock monitoring wells and sampling for VOCs would be necessary to characterize the vertical and horizontal extent of the MSP site contamination, with the work performed from 2008 to 2016.

From 2010 to 2012, the hydrogeologic characteristics of the shallow bedrock were investigated at the onset of this effort to aid in delineating the extent of the VOC contamination at the site. These objectives were accomplished by installing bedrock test holes, collecting depth discrete samples, completing various geophysical borehole tests, aquifer testing, and installing additional bedrock monitoring wells for sampling.

From 2013 through 2016, investigations of the bedrock aquifer focused on determining the extent of VOC contamination that impacted the bedrock aquifer. The investigation identified three transmissive fractures or bedding planes that contained VOC contamination, and these were named Unit B, Unit C, and Unit D for simplicity to reference (see Figure 2-2). Wells were placed in Units B, C, and D, with well screen lengths ranging from 10 to 25 feet in length. Unit B is the shallowest bedrock fracture/bedding plane and also where the highest concentrations of VOCs were found. Units C and D are deeper, parallel, fracture/bedding plane units that are located about 25 feet and 80 feet beneath Unit B, respectively. The concentrations of VOCs detected in these units are much lower than those detected in Unit B, with concentrations in Unit C higher than concentrations in Unit D. The VOCs investigated at the site were primarily CT, TCE, and chloroform. This action was completed in early 2016.

In 2014 and 2015, two additional groundwater sampling events (SE 15 and SE 16) were conducted, and the monitoring wells were sampled for VOCs (both overburden and bedrock wells) and uranium (overburden wells only). High concentrations of VOCs were detected in the samples from bedrock wells but not from overburden wells. Although uranium was detected in overburden wells, the concentrations were below the USEPA MCL for drinking water. The low levels of uranium in the overburden groundwater samples indicate that only residual uranium from past operations remains in the overburden. This trend was expected

after the removal of on-site soils during the OU1 remedial action completed in 2008.

2.5 Past and Recent Remedial/Removal Actions

Oak Ridge National Laboratory conducted the first environmental investigation in 1976 and radiological contamination was found on the MSP site as well as nearby properties. In 1980, the MSP was placed in USDOE custody. From 1981 to 1986, the USDOE conducted removal actions to remediate the vicinity properties, including the removal of contaminated soils from a church rectory, a residence less than a mile from the MSP, the Middlesex Municipal Landfill, and parcels of land adjacent to the MSP site, and along both the South Drainage Ditch and Main Stream. This radiological material had migrated off-site through several means. Properties adjacent to the site were likely contaminated through overland flow as stormwater carried uranium ore spilled on the surface of the site to surrounding properties. In addition, records indicate that waste soils generated during on-site construction activities in the late 1940s and 1950s may have been used as fill materials on parcels away from the site and as cover material in the landfill.

The radioactively contaminated soil that was generated as a result of these remedial efforts was temporarily stored on specially constructed pads at the MSP site. One asphalt pad stored waste material from properties located in the vicinity of the site and had had a volume of approximately 35,200 cubic yards. The other storage pad contained soils from the Middlesex Municipal Landfill and contained approximately 31,200 cubic yards of contaminated material. Both soil piles were removed from the site and transported to off-site disposal facilities. The Middlesex Municipal Landfill pile was removed in 1998 and the vicinity properties pile in 1999.

Post Remedial Action Report (PRAR)

The OU1 remedial action at the MSP site began in September 2006 and was completed in June of 2008. The PRAR stated 87,690 tons (or 324,777 cubic yards) of material were removed from the MSP site and disposed of off-site at a licensed disposal facility. The total volume of contaminated material removed from the MSP site and shipped off site to a licensed disposal facility was 41,244 cubic yards of radiologically impacted soil and debris, and approximately 4,454 cubic yards of chemically impacted waste. Legacy building foundations, drainage structures, and the settling basin were also removed from the MSP site during excavation and disposed of off-site at a licensed disposal facility. Additionally, clean backfill material was placed in the excavation areas (USACE 2010). No remedial/removal actions were ever conducted for groundwater at the MSP site.

3 Site Characteristics

Nature and Extent of Contamination

The release area for CT, chloroform (a breakdown product of CT), and TCE appears to be limited to a small sump that was located in the former Process Building. This sump was used to dispose of wastewater and may have been used for the disposal of non-water residuals, although site records do not indicate the use of solvents as part of site operations. This sump was 12 feet long, 6 feet wide, and 10 feet deep and had a feeder line leading from it to the main pipe storm water line. Records indicate that the sump was open and in communication with groundwater. The bottom of the sump would have been near the interface of the overburden groundwater unit and on top of the unsaturated weathered bedrock, providing a migration pathway directly to the bedrock aquifer. Residuals disposed of at this depth would have spread downward and outward from this point along fractures and partings within the unsaturated bedrock before reaching the water table. CT, TCE, and chloroform were not detected in groundwater samples collected from the overburden wells or overburden screening samples during the most recent sampling events (SE 15 and SE 16). The release area for the uranium contamination was general to the surface of the former operating areas primarily on the northern portion of the site. Uranium ore handling resulted in spilling of the ore on the grounds of the property during loading and unloading of rail cars and storage areas. In addition, crushing of ore in the process building also generated dust, which likely spread outside of the building and onto site grounds resulting in soil contamination. As discussed in Section 2.5 a remedial action has been completed to address this contamination.

Groundwater at the MSP site flows in overburden (deposits consist of artificial fill, unconsolidated sediments [clayey fine sands to silty sands]) and underlying bedrock aquifers. Uranium contamination in groundwater at the MSP site is located in the overburden groundwater unit that generally lies within 10 feet of the ground surface and is relatively thin (up to several feet). The groundwater in the bedrock aquifer occurs 15 to 24 feet below ground surface and extends up to 1,500 feet deep. The overburden aquifer flow is separated from the bedrock aquifer by extremely weathered bedrock where silts and clays have tended to plug or fill the fractures, which reduces the flow down into the bedrock aquifer.

Groundwater samples from the overburden and shallow bedrock aquifers have been collected at the MSP site from the early 1980s to 2016. The contaminants identified in the groundwater as COCs were natural uranium, CT, TCE, and

chloroform. Figure 3-1 shows the MSP-related CT, TCE, and chloroform plumes in Unit B bedrock groundwater from the last groundwater sampling event (SE 16). A uranium plume figure was not created since uranium was not detected above the ARAR of 30 micrograms per liter (µg/L) in SE 16. Figure 3-2 includes the uranium sample results from overburden monitoring wells collected from 2008 to 2015. Exceedances of uranium in the overburden groundwater have not occurred at MSP since 2012 (SE 13).

Concentrations of COCs in the overburden groundwater unit (uranium) and Unit B bedrock groundwater (VOCs) at the MSP site are presented in Table 3-1.

A review of the COC evaluation at the MSP site indicates the following:

- The radiological contaminant of concern in site groundwater is uranium. Since completion of the OU1 soils remedial action, uranium concentrations in the overburden groundwater have decreased. Several wells exhibited elevated concentrations since that action (MW-OB-7, MW-OB-8, MW-OB-10, and MW-OB-12), with results marginally above criteria, and only MW-OB-7 and MW-OB-10 had an exceedance in 2012. Both MW-OB-7 and MW-OB-10 contained concentrations of uranium above the MCL in more than one sampling event. Overburden wells MW-OB-7 and MW-OB-10 were abandoned because the filter packs were saturated with silt, and the presence of silt in samples is thought to be the cause of exceedances in both wells. MW-OB-7 was replaced in August 2014 with MW-OB-7R within 10 feet of the original location. Well MW-OB-7R was sampled in October 2014 and November 2015. MW-OB-10 was not replaced as adjacent wells MW-OB-12 and MW-OB-13 provide sufficient monitoring. No exceedances were detected in the most recent sampling events of 2014 and 2015. Since this contaminant is associated with past site operations and was found in site groundwater at concentrations above regulatory cleanup levels, it was identified and retained as a COC.

  The VOCs found in the MSP site groundwater at elevated levels included: tert-butyl-alcohol, methyl-tert-butyl-ether, tetrachloroethene, methylene chloride, CT, TCE, 1,1-dichloroethene (1,1-DCE), and chloroform. For one or more of the following reasons, the VOCs tert-butyl-ether, methyl-tert-butyl-ether, tetrachloroethene, 1,1-DCE, and methylene chloride are not listed as COCs because: (1) their presence in wells located in the upgradient portion of the site, adjacent to an auto salvage yard, indicates migration from an off-site non-FUSRAP source; (2) they are not related to past FUSRAP on-site activities; (3) they were not determined to present a risk to human health; or (4) some VOCs, such as methylene chloride, acetone, 2-butanone, and toluene, are identified in the Risk Assessment Guidance for Superfund Part A (USEPA 1989) as commonly used organic chemicals in the laboratory and may be introduced into a sample from laboratory cross-contamination, not from the site, and thus can be excluded. CT, TCE, and chloroform were all identified in the site's supplemental risk assessment as contaminants posing potential risks and hazards. Chloroform is a breakdown product of CT and is

likely present only as a result of natural degradation of the CT. Although site records do not indicate the use of solvents as part of site operations, these COCs (CT, TCE, and chloroform) will be addressed due to possible future redevelopment of the site, property transfer (if determined to be excess to federal needs), or to prevent potential future use of impacted groundwater on the property since consumption of the chemically contaminated groundwater would represent an unacceptable risk.

Principal Threat Wastes

According to the USEPA, "Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur" (USEPA, 1991). Decisions to treat any wastes are made on a site-specific basis through a detailed analysis of alternatives, using the remedy selection criteria that are described below in Section 7, Evaluation of Alternatives, of this Proposed Plan. This analysis provides a basis for making a statutory finding as to whether the remedy employs treatment as a principal element. Principal threat wastes are not present at the site.

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Document Path: L:\Buffalo\Middlesex\2016\Maps\MXD\Tech_Memo\2017_07\Figure_16_TCE November 2012 Bedrock Wells_UnitB.mxd

EE-MW-42B
ND; ND

EE-MW-43B
0.80 J; ND

EE-MW-39B
1.8 J; 6.9 J

EE-MW-38B
2.1 J; 7.7 J

EE-MW-37B
0.78 J; 3.9 J

EE-MW-36B
1.2 J; ND

ECC-MW-24B
5.2; 7.6

ECC-MW-27B
17 J; 22 J

ECC-MW-28B
0.68 J; 4.5 J

ECC-MW-26B
0.32 J; 3.2 J

ECC-MW-29B
14; 23

ECC-MW-35B
23; 3.0 J

ECC-MW-32B
0.45 J; ND

ECC-MW-33B
ND; ND

ECC-MW-31B
ND; ND

ECC-MW-30B
50; 1200; 75

ECC-MW-34B
14; 22

EE-MW-40B
ND; ND

URS-MW-2D
24 J; 7.4 J

1
45
70
1000

See Inset A

Clarendon Ave
Edgeworth St
Lorraine Ave
Howard Ave
Cook Ave
Mountain Ave
Pershing Ave
Sheridan Ave
Drake Ave
Voorhees Ave
Madison Ave
Harris Ave
Lincoln Blvd
McKinley Ave
South Ave
Blackford Ave
Egel Ave
Wood Ave
William St
Chariot Ct
Sewell Ave
Lackland Ave
Jersey Ave
Ct R
Vasser Dr
Barclay Sq
Ct P
Wayne Ave
Wayne St

Inset A
Scale 1:3,500

Unit B

Legend

- Unit B Monitoring Well with CT and TCE Concentrations in micrograms per liter (µg/L)
- Property Line
- General Direction of Groundwater Flow - Unit B
- Carbon Tetrachloride Concentration - Unit B
- Trichloroethene Concentration - Unit B
- Chloroform Concentration - Unit B

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0 100 200 400 Feet

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Middlesex, New Jersey

Figure 3-1
Unit B
Trichloroethene, Carbon Tetrachloride, and Chloroform Concentration Contours
SE16 2015 - 2016

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02:1003239.0004.04-B48400\Figure3-2-Uranium_Sample_Results_Overburden_Wells_Reduced-edited by graphics_DT-10/3/18
Path: L:\Buffalo\Middlesex\2016\Maps\MXD\Working\2017_Aug\Figure1_2_Uranium_Sample_Results_Overburden_Wells.mxd

MW-OB-1	
Aug 2008	3.63
Nov 2008	1.83
Feb 2009	1.89
Dec 2009	1U
Apr 2010	1U
Nov 2010	1.60
May 2011	1.20
Aug 2011	1U
Nov 2011	1U
Feb 2012	0.67 J
June 2012	0.96 J
Aug 2012	0.74 J
Nov 2012	1.20
Oct 2014	0.317
Nov 2015	0.321

MW-OB-2	
Aug 2008	3.55
Nov 2008	1U
Feb 2009	2.98
Dec 2009	1U
Apr 2010	1U
Nov 2010	1.40
May 2011	1U
Aug 2011	1U
Nov 2011	1U
Feb 2012	1U
June 2012	1U
Aug 2012	0.77 J
Nov 2012	0.27 J
Oct 2014	0.350
Nov 2015	0.112 J

MW-OB-3	
Aug 2008	10.40
Nov 2008	14.00
Feb 2009	7.49
Dec 2009	2.59
Apr 2010	3.16
Nov 2010	5.50
May 2011	1.40
Aug 2011	1.7
Nov 2011	1.9
Feb 2012	1.6
June 2012	2.1
Aug 2012	0.60 J
Nov 2012	3.0
Oct 2014	2.62
Nov 2015	3.62

MW-OB-4	
Aug 2008	1U
Nov 2008	2.98
Feb 2009	1.50
Dec 2009	1U
Apr 2010	1U
Nov 2010	0.34
May 2011	1.2
Aug 2011	1U
Nov 2011	1U
Feb 2012	1U
June 2012	1U
Aug 2012	2.9
Nov 2012	1U
Oct 2014	0.975
Nov 2015	2.04

MW-OB-5	
Aug 2008	7.67
Nov 2008	4.78
Feb 2009	2.81
Dec 2009	2.02
Apr 2010	1.99
Nov 2010	3.10
May 2011	1.2
Aug 2011	1.4 UJ
Nov 2011	1.9
Feb 2012	2.9
June 2012	0.79 J
Aug 2012	1.8
Nov 2012	3.4
Oct 2014	0.418
Nov 2015	1.94

MW-OB-6	
Aug 2008	3.31
Nov 2008	2.75
Feb 2009	3.72
Dec 2009	1U
Apr 2010	1U
Nov 2010	9.60
May 2011	0.65
Aug 2011	1U
Nov 2011	0.49 J
Feb 2012	0.93 J
June 2012	0.24 J
Aug 2012	1U
Nov 2012	0.54 J
Oct 2014	0.698
Nov 2015	2.82

MW-OB-7/7R*	
Aug 2008	**35.10**
Nov 2008	**36.10**
Feb 2009	**38.10**
Dec 2009	10.70
Apr 2010	11.10
Nov 2010	**41.10**
May 2011	15
Aug 2011	5.8
Nov 2011	10.4
Feb 2012	**32.3**
June 2012	9.0
Aug 2012	10
Nov 2012	**44**
Oct 2014	8.64
Nov 2015	9.14

MW-OB-8	
Aug 2008	**34.20**
Nov 2008	6.89
Feb 2009	2.55
Dec 2009	1.24
Apr 2010	5.69
Nov 2010	25.80
May 2011	1.7
Aug 2011	1U
Nov 2011	4.4
Feb 2012	1.6
June 2012	4.4
Aug 2012	18
Nov 2012	11
Oct 2014	3.39
Nov 2015	2.78

MW-OB-9	
Aug 2008	18.20
Nov 2008	6.36
Feb 2009	10.50
Dec 2009	2.80
Apr 2010	4.53
Nov 2010	1U
May 2011	0.72
Aug 2011	1U
Nov 2011	1.2
Feb 2012	0.60 J
June 2012	0.57 J
Aug 2012	4.2
Nov 2012	2.3
Oct 2014	DRY
Nov 2015	0.780

MW-OB-10*	
Aug 2008	4.30
Nov 2008	7.23
Feb 2009	23.60
Dec 2009	19.20
Apr 2010	NS
Nov 2010	3.60
May 2011	5.5
Aug 2011	1.2
Nov 2011	13.2
Feb 2012	5.9
June 2012	**51**
Aug 2012	**40**
Nov 2012	NS
Oct 2014	AB
Nov 2015	AB

MW-OB-11	
Aug 2008	3.38
Nov 2008	2.71
Feb 2009	3.64
Dec 2009	1.12
Apr 2010	1.44
Nov 2010	0.27
May 2011	0.81
Aug 2011	1U
Nov 2011	0.39 J
Feb 2012	0.45 J
June 2012	1U
Aug 2012	1U
Nov 2012	0.31 J
Oct 2014	0.479
Nov 2015	0.447

MW-OB-12	
Aug 2008	1U
Nov 2008	2.98
Feb 2009	4.03
Dec 2009	3.03
Apr 2010	4.54
Nov 2010	8.50
May 2011	**43.5**
Aug 2011	9.3
Nov 2011	17.7
Feb 2012	5.5
June 2012	8.4
Aug 2012	5.9
Nov 2012	7.8
Oct 2014	DRY
Nov 2015	3.08

MW-OB-13	
Aug 2008	7.15
Nov 2008	5.74
Feb 2009	2.79
Dec 2009	4.03
Apr 2010	2.84
Nov 2010	3.10
May 2011	1.9
Aug 2011	2.6
Nov 2011	2.0
Feb 2012	1.8
June 2012	1.8
Aug 2012	2.6
Nov 2012	1.8
Oct 2014	2.14
Nov 2015	2.27

B18W29SR	
Aug 2008	7.65
Nov 2008	14.00
Feb 2009	7.86
Dec 2009	8.72
Apr 2010	7.38
Nov 2010	1.90
May 2011	7.9
Aug 2011	6.4
Nov 2011	10.6
Feb 2012	2.2
June 2012	3.2
Aug 2012	0.82 J
Nov 2012	3.3
Oct 2014	0.738
Nov 2015	1.15

MW-OB-13
MW-OB-10*
MW-OB-12
MW-OB-1
MW-OB-9
MW-OB-8
MW-OB-7/7R*
MW-OB-6
MW-OB-2
MW-OB-3
MW-OB-5
B18W29SR
MW-OB-4
MW-OB-11

LEGEND:

Overburden Monitoring Well

Property Line

Gravel Area

MW-OB-8	
Aug 2008	**34.20**

Bold Font/Blue Cell – Value meets or exceeds the USEPA Maximum Contaminant Level (MCL) of 30 micrograms per liter (µg/L) for uranium. All results are shown in µg/L.

Key:
AB - Well Abandoned, no sample collected.
J - Estimated value.
NS - No sample was collected for analysis due to insufficient water.
SE - Sampling event.
U - Not detected. Analyte is not present at a level greater than the reporting limit.
UJ - Not detected. The reporting limit is estimated.

Notes:
Samples were not collected for total uranium during SE 14, only volatile organic compounds.

*Wells MW-OB-7 and MW-OB-10 were abandoned in October 2014. MW-OB-7 was replaced with MW-OB-7R near the original location.

N

0 25 50 100 Feet

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Middlesex Sampling Plant
Middlesex, New Jersey

Figure 3-2
Uranium Sample Results
From Overburden Monitoring Wells

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Table 3-1 Concentrations of Overburden, Shallow Bedrock/Unit B Bedrock COCs

Parameter	Number of Wells	Maximum Detection	Minimum Detection	Average Concentration
Uranium	15	51 µg/L in MW-OB-10	0.112 µg/L	6.36 µg/L
Carbon Tetrachloride	35	13,000 µg/L in EE-MW-30B	0.24 µg/L	282.11 µg/L
Trichloroethene	35	430 µg/L in ECC-MW-30B	0.15 µg/L	27.11 µg/L
Chloroform	35	600 µg/L in ECC-MW-30B	0.22 µg/L	18.31 µg/L

Note: Information included in the table is based on data collected from 2008 to 2015. Exceedances of uranium in the overburden groundwater have not occurred at MSP since 2012 (SE 13).

Key:
µg/L = micrograms per liter

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4 Summary of Site Risks

Two human health risk assessments (HHRAs) were conducted for the MSP site groundwater to determine the current and future cancer risks and non-cancer hazards from exposure to COCs in groundwater. A Baseline HHRA was developed in 2005 as part of the Groundwater OU2 RI (USACE 2005b), and a Supplemental HHRA was completed following the soils remedial action using groundwater data collected during the period from 2014 through 2016 investigations (USACE 2017b). The Baseline HHRA evaluated the cancer risks and non-cancer health hazards from COPCs (e.g., radionuclides, VOCs, semivolatile organic compounds, and metals) in on-site groundwater to future residential receptors at the site in the absence of institutional controls (e.g., CEA or other restriction on groundwater use). The cancer risks and non-cancer hazards from surface water and sediment exposures to recreational receptors (trespassers) were also evaluated. Based on the findings presented in the groundwater investigation reports and the results of the risk assessments completed for the MSP, the surface water and sediment do not pose unacceptable risks. Therefore, surface water and sediments do not require further evaluation. The Supplemental HHRA for the MSP site evaluated the risks from COCs in groundwater (VOCs) to future on-site workers and future off-site residential receptors. Groundwater sample results for the two most recent sampling events (2014 and 2015) from five wells within the core of the plume were used for the Supplemental HHRA.

A Screening Level Ecological Risk Assessment (SLERA) performed in 2005 concluded that ecological impacts from contaminants in surface water and sediment were unlikely (USACE 2005a). Further, no sensitive habitat was identified on site, and it was determined that current and potential future land uses on site made it unlikely that the area would be a significant ecological habitat. The MSP site is currently undeveloped, vacant land covered with grass and zoned for industrial use by the Borough of Middlesex Planning Commission. There are no known plans for future use of the MSP land.

An additional SLERA was completed in 2016 as part of the OU2 Groundwater RI (USACE 2017b) and evaluated the potential for harmful effects to ecological receptors exposed to chemicals and radionuclides released from the facility to surface water and sediments. Maximum concentrations of metals, organic compounds, and radionuclides were used to assess potential risk to these receptors.

The following paragraphs present the results of the HHRAs and SLERAs.

Baseline HHRA Results

The following contaminants were identified as COCs in groundwater during the 2005 Baseline HHRA: uranium (as a toxic metal); uranium-238 and uranium-234 (as radioactive contaminants); CT; and manganese. The soil removed as part of the OU1 remedial action (completed in 2008), resulted in a decrease in the concentrations of uranium in groundwater. Concentrations of uranium in groundwater samples have not exceeded the USEPA MCL for uranium in drinking water since 2012 (SE 13).

There was no evidence that manganese was a site-related contaminant. Manganese was determined to be part of the natural background at the site (Serfes 1994). Therefore, manganese was not retained as a COC.

Supplemental HHRA Results:

The supplemental HHRA identified the following contributors to risks exceeding the cancer risk range and the goal of protection for risk of non-cancer health complications. The risk of developing cancer was compared to the risk range of 10^{-4} to 10^{-6} established in the NCP. This means an increased risk of developing cancer of one in ten thousand to one in one million. The non-cancer effects of chemicals are evaluated based on toxicity and are expressed as a Hazard Index (HI). An HI greater than 1 may be a concern for potential non-cancer effects.

- Consumption of groundwater by a future adult worker under a future scenario results in a total cancer risk of 7×10^{-4}, based primarily on exposure to CT. The non-cancer HI for the adult worker from exposure to groundwater was 8.6 due to exposure to CT and TCE. The HI exceeds the goal of protection of an HI less than 1.
- Consumption of potable groundwater by a future child resident resulted in a cancer risk of 1.3×10^{-3}, primarily from exposure to CT. The HI for the child resident exposure to groundwater was 63.3, which exceeds the goal of a protection of an HI less than 1. The contributors to the HI were CT, chloroform, and TCE.
- Potable groundwater use by the adult resident results in a total cancer risk of 3.5×10^{-3}, primarily from exposure to CT and chloroform. The HI for the adult resident exposed to groundwater was 49.3, which exceeds the goal of protection of an HI less than 1. The main contributors were CT, chloroform, and TCE.

Site-related Evaluation. Low levels of VOCs have been found in off-site wells, indicating that off-site sources of VOCs are impacting groundwater quality at the MSP site. However, the USACE will address VOC contamination in consideration of future redevelopment of the site and potential future use of impacted groundwater on the property as a potable drinking water source.

Vapor Intrusion. VOCs present in unsaturated soil or in the dissolved phase in groundwater can act as a source for contaminant vapors that have the potential to migrate into indoor air. For a health risk to exist, a source, a receptor, and a pathway must be present. Vapors migrating upward can accumulate beneath relatively impermeable structures such as buildings and potentially migrate into buildings, posing a potential health risk.

Potential sources for vapor intrusion at the site may include contaminated soils and groundwater. VOCs were not detected in soils during the OU1 remedial investigation in sufficient concentrations or frequency to consider them site COCs (USACE 2004). In addition, unsaturated site soils were removed during the OU1 remedial excavation in 2008 and backfilled using clean fill (USACE 2010b). Therefore, there is no source of VOCs in site unsaturated soils on the MSP property that could produce vapors, and this potential pathway does not exist currently or in the future on this site. VOCs were not detected in the saturated overburden unit at concentrations greater than USEPA Vapor Intrusion Screening Levels or NJDEP Generic Vapor Intrusion Screening Levels for groundwater in the saturated overburden unit (USEPA 2016a; NJDEP 2013). VOCs were detected in the bedrock aquifer at concentrations above both federal and state groundwater screening levels for vapor intrusion.

Although a groundwater source and existing and potential future receptors are present, the saturated overburden unit provides a barrier above the contaminated groundwater that blocks potential upward vapor migration. Therefore, no pathway for vapor intrusion into indoor air from soils and groundwater exists at the site. This data indicates a reduced potential for human health risks from exposure to vapors.

HHRA Results. Based on the calculated cancer risks and non-cancer hazards described above, CT, chloroform, and TCE were identified as COCs in the Supplemental HHRA. The preferred remedy identified in this Proposed Plan is necessary to protect public health from actual or future exposure to hazardous substances into the environment.

SLERA Results

Additional information on VOCs collected during the supplemental groundwater sampling and documented in the *Groundwater Investigation Technical Memorandum* indicated that site-related VOCs are migrating off-site via bedrock bedding planes that do not discharge into surface water systems (USACE 2017b) and there is no pathway to ecological receptors. In addition, no ecological habitats have been identified at the MSP site.

What are the "Contaminants of Concern"?

***CT**: CT was detected in groundwater with the highest concentration of 13,000 µg/L in 2012. CT was historically used in the production of refrigeration fluid and propellants for aerosol cans, degreaser, pesticide, and in fire extinguishers and spot removers. The USEPA's Integrated Risk Information System (IRIS), a source of consensus toxicity values used in HHRAs developed under the CERCLA process, indicates that non-cancer toxicity values used in the HHRA is based on effects on the liver. Inhalation toxicity values are based on hepatic effects. CT is classified as Likely to be Carcinogenic to Humans.*

***TCE**: TCE was detected in groundwater with the highest concentration of 430 µg/L in 2012. TCE is a halogenated organic compound historically used as a solvent and degreaser in many industries. The toxicity values used in the HHRA are based on the IRIS chemical file. Non-cancer values are based on developmental effect and effects on the immune system. TCE is considered carcinogenic to humans and has a mutagenic mode of action.*

***Chloroform**: Chloroform was detected in groundwater with the highest concentration of 600 µg/L in 2012. The toxicity values used in the HHRA are based on the IRIS chemical file. Non-cancer values are based on effects on the liver. The weight of evidence shows that chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues (USEPA 1998a,b).*

***Uranium**: Uranium was detected in groundwater with the highest concentration of 51 µg/L in 2012. The radiological contaminants detected above regulatory cleanup levels at the site are total uranium (i.e., U-234, U-235, and U-238). This contaminant can have both chemical and radiological effects. For example, U-234, U-235, and U-238 (measured as total uranium) were identified in the risk assessment as potentially posing an unacceptable chemical hazard, and U-234 and U-238 (both components of total uranium) were also identified as potentially posing unacceptable carcinogenic risks due to radiological effects.*

What is Risk and How is It Calculated?

A Superfund HHRA is an analysis of the potential adverse health effects caused by hazardous substances releases from a site in the absence of any actions to control or mitigate these releases; it estimates the "baseline risk" in the absence of any remedial actions at the site under current and future land uses. To estimate this baseline risk at a Superfund site, a four-step process is used to assess site-related human health risks for reasonable maximum exposure scenarios. These steps are identified below.

Hazard Identification: *The hazard identification step identifies the contaminants of concern at the site in various media (e.g., soil, groundwater, surface water, air) based on such factors as toxicity, frequency of occurrence, fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.*

Exposure Assessment: *In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil.*

Factors relating to the exposure assessment include but are not limited to the concentrations that people might be exposed to and the potential frequency and duration of exposure. Using these factors, a "reasonable maximum exposure" (RME) scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Toxicity Assessment: *The toxicity assessment determines the types of adverse health effects associated with chemical exposures and the relationship between the magnitude of exposure (dose) and severity of adverse effects (response). Potential health effects are chemical specific and may include the risk of developing cancer over a lifetime or non-cancer health effects such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and non-cancer health effects.*

Risk Characterization: *This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. Exposures are evaluated based on the potential risk for developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess cancer risk", or one additional cancer in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current federal Superfund guidelines for acceptable exposures are an individual lifetime excess cancer risk in the range of 10^{-4} to 10^{-6} (corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk). For non-cancer health effects, a "hazard index" (HI) is calculated. An HI represents the sum of the individual exposure levels compared to their corresponding reference doses (RfDs). The key concept for a non-cancer hazard index is that a "threshold level"(measured as an HI = 1) exists below which non-cancer health effects are not expected to occur.*

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5 Remedial Action Objectives and Proposed Cleanup Levels

Remedial actions that "clean up" hazardous substances at CERCLA sites must clean to levels set by Applicable or Relevant and Appropriate Requirements (ARARs), if there are any. ARARs are federal environmental and state environmental and facility siting laws that must be attained (or waived) by a Superfund remedial action. There are three types of ARARs: chemical-specific, location-specific, and action-specific. There are no location-specific ARARs associated with the MSP site. Chemical-specific ARARs for the MSP site include the federal and state MCLs for uranium and New Jersey Groundwater Quality Standard for CT, TCE and chloroform which are the cleanup levels for groundwater at the site. In the case of differing standards or criteria, the most stringent criterion becomes the ARAR. For action-specific ARARs, only the requirements for Underground Injection Control (authorized under the Safe Drinking Water Act) apply to the MSP. This ARAR regulates injection of fluids, including air, into the groundwater, and will affect the site cleanup if Alternative 3 is approved for the MSP.

The chemical-specific cleanup levels that have been identified for the proposed groundwater remedial action are included in Table 5-1.

Table 5-1 Cleanup Levels for Groundwater Remedial Action at the MSP Site

Contaminant of Concern	Groundwater Cleanup Levels («g/L)[a]	Source for Cleanup Level
Uranium	30 µg/L[b]	40 CFR §141.66 (e) & N.J.A.C. 7:10-5.1
Carbon tetrachloride	1 µg/L[c]	New Jersey GWQS PQL
Trichloroethene	1 µg/L	New Jersey GWQS
Chloroform	70 µg/L	New Jersey GWQS

Notes:

[a] The lowest of USEPA's MCLs (40 CFR Part 141), New Jersey GWQC or PQL (NJAC 7:9C), or NJAC 7:10.

[b] The uranium MCL of 30 µg/L is protective of kidney toxicity and cancer risk associated with uranium-234 and uranium-238 radioactivity (USEPA 2000). Therefore, separate cleanup levels were not established for the uranium isotopes.

[c] Although the New Jersey GWQC for carbon tetrachloride is 0.4 µg/L, the cleanup level selected for this site is 1 µg/L because 0.4 µg/L is below the reportable level for most analytical methods.

Key:
CFR = Code of Federal Regulations
GWQC = Groundwater Quality Criteria
µg/L = micrograms per liter
PQL = Practical Quantitation Limit
MCL = Maximum Contaminant Level

As required by the NCP, site-specific remedial action objectives (RAOs) were established that take into account the nature and extent of contamination, resources that are currently and potentially threatened, and potential for human and environmental exposure (USEPA 1990).

The RAOs are based on mitigating human exposure to COCs in groundwater that exceed the cleanup levels for the contaminated site groundwater. These exposures may occur by ingestion of groundwater; and indoor use of groundwater, such as showering, cooking, and washing clothes or dishes. The RAOs established for the site are:

- to prevent current and future exposure of human receptors (via ingestion, dermal contact, and inhalation) to site related contaminants in groundwater; and
- return groundwater to its most beneficial use as a source of drinking water.

6 Summary of Remedial Action Alternatives

The focus of the remedial action alternatives is to meet the RAO associated with residual low-level radionuclides (uranium) in the overburden groundwater unit and VOCs in the underlying unsaturated bedrock and bedrock aquifer, primarily Unit B.

Four alternatives were evaluated for the Groundwater OU remediation:

- Alternative 1 – No Action;
- Alternative 2 – Monitored Natural Attenuation and Land Use Controls;
- Alternative 3 – Treatment with In situ Chemical Reduction, Monitored Natural Attenuation, and Land Use Controls; and
- Alternative 4 – Pump and Treat, Monitored Natural Attenuation, and Land Use Controls.

The development of these alternatives considers the fact that the on-site contaminated soil has been excavated and backfilled with clean soil during the OU1 remedial action. The replacement of contaminated soil with clean soil resulted in significant reduction of uranium concentrations in the overburden groundwater. However, it was assumed that residual levels of uranium contamination in groundwater could remain and would need to be addressed by a remedial action.

The alternatives also address VOC contamination that are attributable to past site activities.

Alternative 1 – No Action

Alternative 1 has been considered in accordance with NCP [40 C.F.R. §300.430(e)(6)] and is intended to provide a baseline comparison to the other alternatives. In this alternative, no remedial systems would be installed or operated, and no LUCs, such as a CEA, would be used for groundwater. Any improvement of the groundwater would be through natural attenuation including dispersion, dilution, and adsorption. There is no capital or present-worth operation and maintenance cost involved with this alternative, since there would be no action taken.

Alternative 2 – Monitored Natural Attenuation and Land Use Controls

Alternative 2 relies upon monitoring of the groundwater contaminant plume to determine whether contamination is being reduced by natural environmental processes as defined in USEPA Office of Solid Waste and Emergency Response Directive 9200.4-17P, Use of Monitored Natural Attenuation at Superfund, Resource Conservation and Recovery Act Corrective Action and Underground Storage Tank Sites, dated April 21, 1999. MNA applicable to the MSP site include dispersion, dilution, and adsorption. All of these processes are applicable to TCE and CT and help reduce contaminant concentrations over time. MNA, such as dispersion, dilution, and adsorption, apply to TCE and CT while dispersion and adsorption are applicable to total uranium. MNA relies on monitoring to determine whether contaminants are spreading beyond current boundaries at concentrations exceeding cleanup levels. The ultimate duration of the groundwater monitoring program would be based on the sample results that demonstrate whether the impacted groundwater has contaminant concentrations that meet the cleanup levels. Under this alternative, it is expected that contaminant concentrations would decrease over time as a result of the source removal completed during the Soils OU1 remedial action in 2008 and natural attenuation. Dispersion processes would be especially effective in diminishing contaminant plumes of limited extent and relatively low concentrations. The decreasing trends or the presence of daughter products (e.g., chloroform, DCE) will be noted as evidence of natural attenuation. These indicators of the occurrence of natural attenuation would also apply to Alternatives 3 and 4, which are further enhanced by the mass removal associated with active treatment. In addition, this alternative contains provisions for implementing LUCs, such as well restrictions in a groundwater CEA in areas where groundwater contamination has been identified. Additionally, physical LUCs, such as warning signs, will notify construction workers of the dermal risks on the site. Since this alternative would take time to achieve the cleanup goal, restrictions on the use of groundwater would have to be implemented until the goal is met. Because the MNA alternative would result in contaminants that remains above cleanup levels that allow for unlimited use and unrestricted exposure, the remedial action would need to be reviewed at least once every five years until cleanup goals are attained. Capital cost for this alternative was estimated at $1,233,000 and the annual operation and maintenance cost was estimated at $149,000. The 30-year present-worth cost for this alternative was estimated to be $2,711,000.

Alternative 3 – Treatment with In situ Chemical Reduction, Monitored Natural Attenuation, and Land Use Controls

Alternative 3 is a combination of remedial technologies to treat the various contaminants present in groundwater. ISCR technologies are proposed to treat the VOCs present in groundwater situated in the fractured bedrock within Unit B on site at the source area. This treatment would eventually eliminate VOCs emanating from the site source area, thereby reducing the long-term chlorinated VOC mass flux from the source area feeding the off-site portion of the plume and isolate groundwater with low concentrations of VOCs in the downgradient portion of the plume. MNA would be applied to the on-site VOCs not influenced

by active treatment, the downgradient portion of the VOC plume, and to any residual uranium present in the overburden groundwater. An LUC, in the form of a groundwater CEA as described under Alternative 2, would be utilized in areas of groundwater contamination present at the site until cleanup goals are achieved. Because this alternative would result in contaminants that remain above cleanup levels that allow for unlimited use and unrestricted exposure during the MNA period, the remedial action would need to be reviewed at least once every five years until cleanup goals are attained.

ISCR applications are anticipated to degrade site COCs with contact and enhance mass reduction. ISCR is typically applied by injecting chemically reductive additives in liquid form into the source area and the areas of elevated VOC concentrations. The ISCR reagent ultimately facilitates the breaking of chemical bonds, eventually transforming groundwater contaminants into less harmful chemical species. ISCR materials are strong reducing agents and have been successful in treating VOCs present in bedrock groundwater as site COCs (TCE, CT and chloroform). Bench-scale and/or pilot tests would be completed during the design phase to determine the effectiveness, appropriate concentrations, and specific volumes of the necessary reagent injections. ISCR would be injected directly into the source area and the areas of elevated VOC concentrations. Capital cost for this alternative is approximately $5,471,500 and the annual O&M cost was estimated to be $162,000. The 30-year present worth was estimated to be $7,833,000.

Alternative 4 – Pump and Treat, Monitored Natural Attenuation, and Land Use Controls

Alternative 4 is a combination of remedial technologies to treat the various contaminants present at the site. Removal of contaminated groundwater by pumping is proposed to address the VOCs (TCE, CT, and chloroform) present in groundwater situated in the fractured bedrock on site. Extraction wells would be placed in the source area and along the downgradient property boundary to control and eventually eliminate VOCs emanating from the source area. This would effectively isolate low concentration areas of the plume observed in deeper wells beneath the site and downgradient of the site. MNA would be applied to these low concentration areas of the VOC plume outside of the active treatment area and to any residual uranium present in the overburden groundwater. An LUC in the form of a groundwater CEA would be utilized in areas of groundwater contamination present at the site until cleanup goals are achieved. Because this alternative would result in contaminants that remain above cleanup levels that allow for unlimited use and unrestricted exposure during the MNA period, the remedial action would need to be reviewed at least once every five years until cleanup goals are attained.

Pump and treat would involve the use of a conventional pump-and-treat system technology. Extraction wells would be placed strategically in the areas of higher concentrations to target contaminant removal and placed in downgradient areas to prevent further migration of the plume. Construction of the pump and treat system would be initiated by installing approximately five groundwater extraction

wells to a depth of 30 feet (in Unit B) in the source area and areas of elevated VOC concentrations to recover as much of the mass as possible in the first 15 years of operations, after which they could then be converted to low flowrate extraction wells with pneumatic pumps for the remaining operational period. In addition, eight wells will be installed in a line along and inside the downgradient property boundary for migration control to a depth of 70 feet (in Unit B), as low flowrate extraction wells pumping at approximately 1 gallon per minute, because of the low transmissivity of the aquifer units. The extracted groundwater would then be treated using an air stripper followed by granular activated carbon polishing. The treated effluent would then be discharged to the local publicly owned treatment works. Capital cost for this alternative is approximately $3,039,000 and the annual operation and maintenance cost was estimated to be $608,000. The 30-year present worth was estimated to be $11,951,000.

7 Evaluation of Alternatives

Each alternative was evaluated during the FS against seven of the nine criteria established by the NCP [40 C.F.R. §300.430(e)(9)(iii)], and summarized in this section. The last criteria (State and Community Acceptance), referred to as the Modifying Criteria will be evaluated after the public comment period as part of the final remedy selection process.

NINE EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES

Protection of Human Health and the Environment *determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.*

Compliance with ARARs *evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.*

Long-term Effectiveness and Permanence *considers the ability of an alternative to maintain protection of human health and the environment over time.*

Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment *evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.*

Short-term Effectiveness *considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.*

Implementability *considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.*

Cost *includes estimated capital and annual operation and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an*

alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

State Acceptance *considers whether the state agrees with the USACE's analyses and recommendations, as described in the RI/FS and Proposed Plan.*

Community Acceptance *considers whether the local community agrees with USACE's analyses and preferred remedy. Comments received on the Proposed Plan are an important indicator of community acceptance.*

Threshold Criteria (must be met)

Overall Protection of Human Health and the Environment. Addresses whether an alternative provides protection and describes how exposure risks are eliminated, reduced, or controlled through treatment, engineering, or LUCs.

Alternative 1 does not provide protection of human health and the environment in the short or long term because it does not reduce risk or exposure from COCs in the groundwater. It also allows for the continued existence of exposure pathways and does not implement any LUCs.

Alternatives 2, 3, and 4 would be considered protective of human health. Although no active remedial treatment measures would occur under Alternative 2, protection in the short-term could still be achieved through implementation of LUCs. Additionally for Alternative 2, a groundwater monitoring program would assess the attainment of the cleanup levels and monitor the progress and rate of natural degradation.

Alternatives 3 and 4 would protect human health and the environment by combining active remediation with the implementation of LUCs and a MNA program, which would assess the attainment of cleanup levels.

Compliance with ARARs/Cleanup Levels. Addresses whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site or whether a waiver is justified.

Under Alternative 1, no action is taken so changes in concentrations of in groundwater COCs would not be documented, and LUCs would not be in place to restrict access to impacted groundwater. Alternative 2 would eventually comply with the cleanup levels through natural environmental processes and LUCs would restrict access to impacted groundwater until the cleanup levels are achieved. Alternative 3 would comply with the cleanup levels through the implementation of MNA to the on-site VOCs not influenced by active treatment, the downgradient portion of the VOC plume and to any residual uranium in the overburden, and through ISCR that would be designed for degradation of VOCs in the bedrock. Alternative 4 would comply with the cleanup levels through the

implementation of MNA to the low concentration areas of the VOC plume outside of the active treatment area and to any residual uranium present in the overburden groundwater, and through pump-and-treat technology that would be designed to extract groundwater impacted by COCs in the bedrock. Alternatives 3 and 4 would also implement LUCs to restrict access to impacted groundwater until the cleanup levels are achieved. Alternatives 2, 3, and 4 would provide a monitoring program to determine when groundwater cleanup levels are achieved for both the saturated overburden unit and bedrock aquifer.

Primary Balancing Criteria (identifies major trade-offs among alternatives)

Short-Term Effectiveness and Environmental Impacts. Addresses the impacts to the community and site workers during the time it takes to complete the action. This criterion also includes an assessment of the relative time frame required for the remedial action to achieve protection.

No changes in potential exposure to workers or negative impacts to the environment would occur under Alternative 1. Alternative 2 would pose little to no additional health risk to the community and workers in the short term because no significant remedial activities would take place. Alternatives 3 and 4 may have a slight increase in risk to workers during the remedial activities. However, these impacts would be mitigated by health and safety measures. Alternative 3 is anticipated to produce a prompt reduction of the COCs other than uranium (which is already below regulatory limits) in the short term since remedial construction and operation activities are designed to target the source area and areas of elevated COC concentrations; LUCs would be implemented within one year. Alternative 4 is anticipated to have a moderate time frame in reduction of the COCs in the short term as the pump-and-treat applications impact zones of contamination; LUCs would be implemented within one year.

Long-Term Effectiveness and Permanence. Refers to the ability of the alternative to protect human health and the environment over time, once cleanup levels have been met.

Alternative 1 does not provide long-term effectiveness since no actions are taken to reduce risk or exposure to COCs in groundwater. Alternative 2 may provide long-term effectiveness as contaminant concentrations in groundwater are reduced due to natural attenuation processes and monitoring would be in place to document this effectiveness; LUCs would be in place to restrict access to impacted groundwater until the cleanup levels are achieved, meeting long-term effectiveness and permanence for protection against exposure to groundwater contamination. Alternative 2 employs no active remediation and relies on the natural attenuation to achieve the remedial goals. This alternative are expected to have a longer timeframe than Alternatives 3 and 4 to achieve the remedial goals.

Alternatives 3 and 4 would offer a higher degree of long-term effectiveness and permanence through the implementation of remedial technologies. Alternative 3

would implement MNA to the on-site VOCs not influenced by active treatment, downgradient portion of the VOC plume and to any residual uranium in the overburden, and ISCR would be designed for degradation of VOCs in the bedrock. Alternative 4 would achieve the cleanup levels through the implementation of MNA to the low concentration areas of the VOC plume outside of the active treatment area and to any residual uranium present in the overburden groundwater. Pump-and-treat technology would be designed to extract groundwater impacted by COCs in the bedrock. Alternatives 3 and 4 also implement LUCs to restrict access to impacted groundwater until the cleanup levels are achieved, providing long-term effectiveness and permanence. Alternative 3 is expected to have a shorter timeframe to achieve the remedial goals than all of the other alternatives as the source area will be treated, leaving behind only low concentrations of COCs. Alternative 4 is expected to achieve the remedial goals in a shorter timeframe than Alternative 2 as the groundwater will be actively remediated.

Reduction in Toxicity, Mobility, or Volume through Treatment. Refers to anticipated ability of the remedy to reduce the toxicity, mobility, or volume of the hazardous components present at the site through treatment.

This evaluation criterion is not applicable to Alternatives 1 and 2. No action occurs under Alternative 1, and Alternative 2 would rely solely on natural processes such as dispersion, adsorption, and dilution to remediate the groundwater at the MSP site. Alternatives 3 and 4 would satisfy the statutory preference for treatment as a principal element and incorporate natural processes occurring under the MNA technology.

Implementability. Addresses the technical and administrative feasibility of an alternative, including the availability of material and services required for cleanup.

Alternative 1 involves no action, so there is nothing to be implemented.

Applications presented under Alternatives 2, 3, and 4 are proven and no major hindrances have been identified or are anticipated with their implementation. Due to the limited actions presented under Alternative 2, it is assumed to be the most straightforward alternative to implement.

Since active remediation is proposed under Alternatives 3 and 4, increased complexity and some uncertainty would exist with their implementation. Their technologies have been proven but problems with implementation are anticipated due to low permeability and the application of these technologies in fractured bedrock flow aquifer units. It is anticipated that these problems can be addressed during the implementation of these technologies. The attainment of necessary permits for potential off-site actions is anticipated to be achievable. In accordance with CERCLA, no permits are required for on-site work although such work would comply with substantive requirements of any otherwise required

permits. No issues are anticipated with sampling and analysis. Some degree of difficulty may occur during the implementation of the remedial process, which would require careful assessment and engineering judgment to determine operating parameters, and these could create additional uncertainties.

Cost. Evaluates the estimated capital, and operation and maintenance costs of each alternative. Cost estimates are expected to be accurate within a range of +50 to -30%.

The estimated total costs are as follows:

- Alternative 1 costs $0;
- Alternative 2 is estimated to cost $2,711,000;
- Alternative 3 is estimated to cost $7,833,000; and
- Alternative 4 is estimated to cost $11,951,000.

Alternatives 3 and 4 would have higher costs than Alternative 2. The technology employed under Alternative 4 would be the most expensive, and the limited actions involved with Alternative 2 would be the least costly. However, Alternative 3 would have a much lower cost to the federal government than Alternative 4.

Modifying Criteria

The modifying criteria are dependent on the comments received. They are formally evaluated after the public comment period. A description of each follows:

State Acceptance. Evaluates whether the State agrees with, opposes, or has no comment on the preferred alternative. Considers whether the State agrees with the USACE's analyses and recommendations, as described in the RI/FS and Proposed Plan. The State of New Jersey is still evaluating the USACE preferred alternative presented in this Proposed Plan.

Community Acceptance. Indicates whether the community has a preference for a remedy and whether community concerns are addressed by the remedy. Considers whether the local community agrees with the USACE's analyses and preferred remedy. Comments received on the Proposed Plan are an important indicator of community acceptance.

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8 Preferred Remedy

Based upon an evaluation of all alternatives, Alternative 3 (ISCR, MNA, and LUCs) is recommended as the preferred remedy for the following reasons:

- The alternative will meet the RAO as described in Section 5;
- The alternative will meet the threshold criteria of protection of human health and the environment and compliance with cleanup levels and will attain cleanup levels;
- The alternative will produce a reduction in the COC concentration in the short term since remedial construction and operation activities are designed to target the source area and areas of elevated COC concentrations. This satisfies the preference for treatment as a principal element;
- The alternative will be effective in the long-term because all contaminated groundwater either will be treated or restricted from use until the cleanup levels are achieved; and
- The results of the groundwater monitoring program will be used to document the progress in attainment of the RAO and cleanup levels and allow unanticipated results to be evaluated and addressed.

ISCR technologies are proposed to treat the VOCs present in groundwater situated in the fractured bedrock onsite at the source area. This treatment would eventually eliminate VOCs emanating from the site source area and leave behind groundwater with low concentration VOCs in the downgradient portion of the plume. MNA would be applied to the on-site low concentration of VOCs not part of the active treatment, downgradient portion of the VOC plume, and to the total uranium present in the overburden.

The ISCR reagent ultimately facilitates the breaking of chemical bonds, eventually transforming groundwater contaminants into less harmful chemical species. The selected reduction reagent would reduce groundwater contaminants such that residual contaminant concentrations are less than the cleanup levels established for the site.

A thorough analysis of available ISCR reagents would be completed during the remedial design to ensure selection of the most efficient and economical reagent. Bench-scale and/or pilot tests would be completed to determine the effectiveness, the appropriate concentrations, and the specific volumes of the reagent necessary

to be injected. The cost analysis would be further refined to ensure the most economical reagent is chosen. To actively address VOC contamination, and depending on the geology present at the location of an injection, ISCR materials would be injected using one or more of the following technologies:

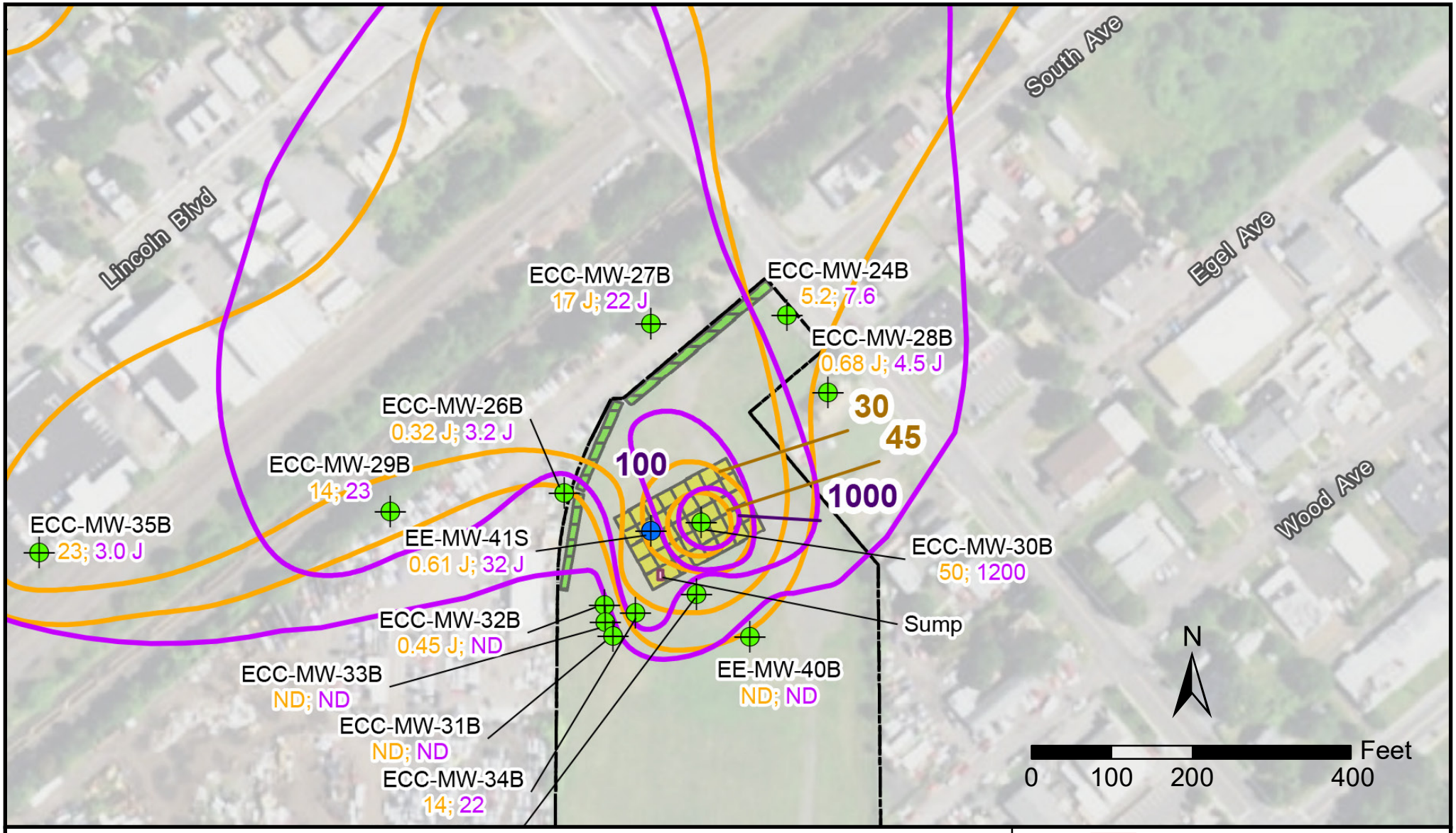
- Direct injection
- Pneumatic injection
- Pressure pulse injection
- Injection wells

ISCR would be implemented through injection wells placed at the source area near the former sump, the areas of elevated VOC concentrations near ECC-MW-30B and along the downgradient property boundary (see Figure 8-1). In the conceptual design, which would be refined during the actual remedial design, the source area and the areas of higher VOC concentrations injection well system would be configured in a grid of six wells by nine wells (54 wells) and a well spacing of 20 feet. The injection wells in the two North-South (N-S) grid lines nearest to the source area and monitoring well EE-MW-41S would be drilled to a depth of 15 feet. Every subsequent two N-S grid lines would be drilled 5 feet deeper (20 feet, 25 feet), with the last three N-S lines of the grid drilled to a depth of 30 feet.

The injection well systems along the downgradient property boundaries would be configured in three lines totaling 500 feet in length; all of these wells would be drilled to a depth of 50 feet. The lines would be oriented perpendicular to the groundwater flow. Wells would be spaced every 20 feet for a total of 25 wells. The total number of injection wells at the source area, areas of elevated VOC concentrations near ECC-MW-30B and at the downgradient property boundary would be approximately 79.

- Additional injections may be warranted to treat downgradient plumes or areas that may be identified to have a potential impact on receptors. Prior to the injection, monitoring wells located in the target zone (Unit B of bedrock aquifer) would be monitored for the following parameters:
- Contaminant levels
- Total Organic Carbon, ORP, pH
- Manganese, iron, chloride, sulfate
- Dissolved hydrocarbon gases (e.g., ethene, ethane, methane)
- Reagent additives or by-products, as necessary

02:1003239.0004.04\Figure_8-1_Injection_Points Wells_Chem_edited by Graphics-9/6/18



Legend

- Shallow Bedrock Monitoring Well
- Unit B Monitoring Well
- Carbon Tetrachloride Isocontour
- Trichloroethene Isocontour
- Property Line
- Sump
- Proposed Lines of Injection Points/Wells
- Proposed Injection Grid on 20-foot Centers

X; X - SE 16 Concentrations (µg/L) of Trichloroethene (TCE); Carbon Tetrachloride (CT)

Notes:

Lines of injection consist of injection points/wells at a 20-foot spacing. Total line length = 500 feet. Total number of points/wells = 25.

6 x 9 injection grid is on 20-foot centers for a total of 54 points/wells.

A total of 79 injection points/wells will inject into the source area, on top of Unit B and into Unit B. Specific injection depths are identified in the text.

Coordinate System:
North American Datum 1983 HARN
New Jersey State Plane FIPS 2600
Units: Feet

UNITED STATES ARMY
CORPS OF ENGINEERS

Middlesex Sampling Plant
Middlesex, New Jersey

Figure 8-1
Alternative 3: In-Situ Chemical Reduction Injection Points/Wells

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The amount of VOC reduction would be assessed by comparing results of pre-injection (baseline) and post-injection groundwater samples. Based on the result of the post-injection sampling, subsequent injections may be required.

The use of LUCs would eliminate or minimize the potential for human exposure at unacceptable levels by direct contact or ingestion of groundwater. The use of ISCR materials injected into the groundwater would reduce concentrations of VOCs and expedite the timeframe required for MNA to attain cleanup levels.

Under this alternative, LUCs would be implemented, such as well restrictions in a groundwater CEA, where groundwater contamination has been identified and construction worker warnings have been issued regarding dermal exposure. CEAs are institutional controls in geographically defined areas within which the New Jersey Groundwater Quality Standards for specific contaminants have been exceeded. Designated aquifer uses are suspended in the affected CEA for the term of the CEA. When the USACE implements LUCs (including a groundwater CEA by the NJDEP) as part of the preferred remedy, they will work with State and local governments and affected property owners to develop and implement appropriate measures intended to restrict the use of groundwater in the area until the COCs meet remediation goals.

CEAs are administered by the State of New Jersey. The state exercises its authority by utilizing a statute that requires the issuance of permits prior to the construction of any groundwater well. The USACE would request the NJDEP to establish a CEA in the affected areas associated with the MSP site. The USACE would assist the NJDEP in establishing the CEA. The CEA would remain in effect until the concentrations of VOCs in the aquifer are below the cleanup levels. In accordance with CERCLA, no permits are required for on-site response actions, including the CEA, but the preferred remedy would comply with other substantive requirements of any otherwise needed permits.

If a CEA is implemented, it would be utilized in areas of groundwater contamination present on, or off, the site until cleanup goals are achieved. The specifics of the monitoring program would be developed in a long-term monitoring plan.

Furthermore, groundwater monitoring will be conducted to ensure that concentrations of the COCs are at, or below, their proposed cleanup goals and to document that natural attenuation occurs. To address potential seasonal variation in contaminant levels, it is proposed to monitor the wells on a quarterly basis for the first two years. The data will be examined to determine whether significant seasonal variation is occurring and, if it is, to identify the season in which maximum concentrations occur. After the two-year period, the frequency of monitoring would be reevaluated in coordination with USEPA and NJDEP to determine if changes, such as decreased frequency or amended parameters, are appropriate.

Implementation of the remedial alternative would be considered complete when the long-term average concentrations of the COCs at each monitoring well no longer exceed their cleanup goals for three consecutive sampling rounds.

It is important to note that the compliance for the stated number of sampling results would not be the sole criteria on which a decision to close the well would be based. Other factors, such as seasonal variations that could affect contaminant concentrations during the period in question or whether the well is in a location that could be impacted by high concentrations of contaminants upgradient in the future, would also be considered.

The location and number of monitoring wells would be reviewed on an annual basis. Wells used for environmental monitoring that become damaged or require removal due to construction or other activities would be replaced or repaired, as needed. The need for continuing the monitoring at the location would be evaluated based on existing and expected future groundwater conditions. Water quality results, and the results of the review, would be provided in the annual monitoring report.

The implementation of the remedial alternative would be considered complete when the long-term average concentrations of the COCs at each individual well do not exceed the cleanup levels for three consecutive sampling events. However, attaining MCLs in a reasonable timeframe could be difficult due to the presence of a complex geology like the bedrock aquifer units at the site. The site concentrations may reach a "plateau condition" above the groundwater remedial goals wherein the concentrations do not continue to reduce due to matrix diffusion rebound from absorbed contaminant mass within the rock matrix and/or immobilized within secondary fractures. To address these conditions, an additional round(s) of injection of ISCR may be evaluated or active treatment may be terminated and transitioned to MNA. Criteria for this evaluation would be developed during the remedial design. The MNA remedy may also experience a plateau condition where statistical decreasing trends are no longer measured but progress will still slowly continue towards attainment of the remedial goals over an extended period of time. If plateau conditions are observed, the remedy and/or RAO may need to be modified (e.g., alternative injection technique or remedial technology or with CEA and LUCs remaining in place indefinitely) in the event findings from the 5-year reviews determine that the cleanup levels will not be met in what is determined by USACE and the USEPA to be a "reasonable timeframe." The modification of the remedy and/or RAO will involve the preparation of an Explanation of Significant Differences or a Record of Decision amendment. During the inspection portion of the 5-year review, a USEPA site inspection checklist will be completed.

Based on information currently available, the USACE and the USEPA believe the preferred remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The USACE expects the preferred remedy to satisfy the following statutory requirements of CERCLA §121(b): 1) be protective of human

health and the environment; 2) be cost-effective; 3) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 4) satisfy the preference for treatment as a principal element (or justify not satisfying the preference). The preferred remedy also complies with ARARs (or justifies a waiver) a required by CERCLA Section 121(d), 42 U.S.C. § 9621(d).

The preferred remedy can change in response to public comment or new information.

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9 Community Participation

Public input is requested and encouraged by the USACE, USEPA, and NJDEP to ensure that the remedy selected for groundwater at the MSP site addresses the concerns and meets the needs of the local community. While this Proposed Plan makes a recommendation for groundwater remediation, the actual remedy will not be selected until all comments have been received and reviewed by the USACE and USEPA, in coordination with the NJDEP.

Written comments about the Proposed Plan will be accepted through the end of the public comment period. The public comment period will run from 24 August 2020 through 25 September 2020. Upon timely request (before the end of the comment period), the comment period may be extended for an additional 30 days. During the comment period, a public meeting will be held to present the conclusions of the RI/FS, elaborate further on the reasons for recommending the preferred remedy, and receive public comments.

Due to the current global COVID-19 pandemic, the public meeting will not be able to be held live at the Middlesex Public Library. Instead, USACE will present the information during an online meeting (in accordance with the USEPA's latest virtual meeting guidance) and will post the Proposed Plan online for review and public comment. The virtual meeting has been scheduled for 31 August 2020, starting at 6 pm.

Written comments will be accepted any time during the comment period, and should be sent to:

Ms. Helen Edge
U.S. Army Corps of Engineers, New York District
26 Federal Plaza, Room 1811
New York, New York 10278-0090
(917) 790-8333

The USACE and USEPA will evaluate comments submitted during the comment period, with responses to significant public comments formally documented in a Responsiveness Summary. After considering all comments, the USACE and USEPA, in coordination with the NJDEP, will make a final decision regarding the groundwater cleanup remedy for the MSP site. The final decision will be detailed in a Record of Decision, which will include the Responsiveness Summary. The

Record of Decision will be incorporated into the administrative record for the site, which is maintained at the following location:

Middlesex Public Library
1300 Mountain Avenue
Middlesex, New Jersey 08846
(732) 356-6602

Business Hours: Monday and Wednesday, 11 AM to 8 PM
Tuesday and Thursday, 1 PM to 9 PM
Friday, 10 AM to 5 PM
Saturday, 10 AM to 2 PM
Sunday, Closed

The Proposed Plan and additional information regarding the MSP site are available on the USACE New York District's website: https://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/487433/fact-sheet-middlesex-sampling-plant-msp/

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