Superfund Program
U.S. Environmental Protection Agency
Region 2
Proposed Plan

Cinnaminson Groundwater Contamination Area
Operable Unit (OU) 03
Cinnaminson and Delran Townships, New Jersey

July 2022

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes the remedial alternatives that the United States Environmental Protection Agency (EPA) considered to remediate soil, groundwater, and soil vapor (also called vapor intrusion (VI)) at the Cinnaminson Groundwater Contamination Superfund Site (Site), located in the Townships of Cinnaminson and Delran, Burlington County, New Jersey, and identifies EPA's preferred alternatives, along with the reasons for these preferences. The Site cleanup is being addressed in four phases or Operable Units (OUs). The Operable Unit 1 (OU1) Record of Decision (ROD) was issued September 1990 and addressed groundwater primarily associated with the Sanitary Landfill, Inc. (SLI) Landfills. The Operable Unit 2 (OU2) ROD was issued in July 2014 and addressed capping of the SLI Landfills. Operable Unit 3 (OU3), which is the subject of this Proposed Plan, addresses contamination associated with the Messer, LLC property (Messer Property) located in Cinnaminson Township. The Operable Unit 4 (OU4) ROD was issued in June 2021 and addresses other site-wide groundwater contamination outside of OU1, OU2, and OU3. The Site was placed on the National Priorities List in June 1986.

The Preferred Alternatives, S2 and G3, described in this Proposed Plan include soil remediation using excavation and off-site disposal, groundwater remediation using in-situ chemical reduction, VI mitigation as required using sub-slab depressurization systems or other appropriate technologies, and institutional controls (ICs). This Proposed Plan was developed by EPA, the lead agency for the Site,

MARK YOUR CALENDAR

Public Comment Period:
August 1, 2022 – August 31, 2022. EPA will accept written comments on the Proposed Plan during the public comment period. Written comments should be addressed to:

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PUBLIC MEETING:
EPA will hold a **Virtual Public Meeting** on **August 10, 2022 at 6:00 PM EST** to explain the Proposed Plan and the other alternatives presented in the Feasibility Study. To register for the public meeting, visit:
https://USEPACinnaminson.eventbrite.com

To learn more about the public meeting, visit:
https://www.epa.gov/superfund/cinnaminson
or contact Natalie Loney, Community Involvement Coordinator at loney.natalie@epa.gov or (212) 637-3639.

Anyone interested in receiving materials for the public meeting in hard copy should either email or call Ms. Loney with such a request by **August 5, 2022**.

The Administrative Record file containing the documents used in developing the alternatives and preferred cleanup plan is available for public review at:
https://www.epa.gov/superfund/cinnaminson

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in consultation with the New Jersey Department of Environmental Protection (NJDEP), the support agency. EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA or Superfund). EPA will select a final remedy for contaminated groundwater, soil and soil vapor at OU3 after reviewing and considering all information submitted during the 30-day public comment period.

COMMUNITY ROLE IN SELECTION PROCESS

This Proposed Plan is being issued to inform the public of EPA's preferred alternatives to address contaminated soil, groundwater, and soil vapor at OU3 of the Site and to solicit public comments pertaining to all of the remedial alternatives evaluated, including the preferred alternatives. EPA may make changes to the preferred alternatives, or change to another alternative, if public comments or additional data indicate that such a change would result in a more appropriate remedial action. The final decision regarding the selected remedy will be made after EPA has taken into consideration all public comments. EPA is soliciting public comments on all of the alternatives considered in the Proposed Plan, because EPA may select a remedy other than the preferred alternatives. This Proposed Plan will be made available to the public for a public comment period that concludes on August 31, 2022.

A public meeting will be held during the public comment period to present the conclusions of the Remedial Investigation and Feasibility Study (RI/FS), to elaborate further on the reasons for proposing the preferred alternatives, and to receive public comments. The public meeting will include a presentation by EPA of the preferred alternatives and other cleanup options.

Information concerning the public meeting and on submitting written comments can be found in the "Mark Your Calendar" text box on Page 1. Comments received at the public meeting, as well as written comments received during the public comment period, will be documented in the Responsiveness Summary section of the ROD. The ROD is the document that explains which alternative has been selected and the basis for the selection of the remedy.

SCOPE AND ROLE

EPA is addressing the cleanup of the Site in four phases or OUs, which address source areas and groundwater contamination that originated from contributing source areas. This Proposed Plan addresses OU3. The OU3 RI/FS was conducted by Messer LLC. The distribution of the volatile organic compounds (VOCs) in groundwater shows source(s) of VOCs in OU3, and groundwater containing VOCs flows both to the northwest, where it potentially discharges to the Delaware River, and the southeast, where it mixes with VOCs from OU1 and other sources. This Proposed Plan addresses groundwater contamination on the Messer Property and groundwater contamination that flows to the northwest from OU3. OU3 soil contamination that contributes to groundwater contamination is also addressed by this Proposed Plan, as is vapor intrusion associated with the OU3 groundwater contamination.

OU1, in accordance with the September 1990 ROD, consists of remediating contaminated groundwater primarily emanating from the SLI Landfills. OU1 is currently undergoing long-term monitoring. OU2 addressed the source area contamination at the SLI Landfills. Landfill caps were constructed in 1987, under NJDEP oversight. After the design, construction and monitoring of an enhanced landfill gas management system and drainage improvements, the OU2 ROD was issued in July 2014. The ROD determined that no further remedial action was necessary for OU2 to ensure protection of human health and the environment. OU4 addresses groundwater contamination within the Site that is not currently being addressed by OU1, OU2, or OU3. The OU4 ROD was issued by EPA in June 2021.

SITE DESCRIPTION

The Site covers approximately 400 acres. The Site is located in the townships of Cinnaminson and Delran, Burlington County, New Jersey and includes properties bounded by Union Landing Road, U.S. Route 130, River Road and Taylors Lane. The Site includes the two closed SLI Landfills, known as the northwest and southeast landfills, along with residential and light to heavy industrial properties. The Delaware River is located northwest of the Site and U.S. Route 130 passes southeast of the Site. Two small streams, Pompeston Creek and Swede's Run, receive run-off from the Site and discharge into the Delaware River. See Figure 1.

OU3 includes soil and groundwater contamination at an industrial facility located on River Road (also called Broad Street): Messer LLC (Messer), formerly known as Linde LLC (Linde), and before that as BOC Gases, formerly a division of The BOC Group, Inc. which became Linde, Inc. by name change, operated a facility located on River Road (also called Broad Street). The current land use at OU3 and the surrounding area ranges from industrial and commercial to residential (Figure 2). An investigation of what is now OU3 was started in 1988 as a result of the sale of a parcel of land, which triggered the property owner to comply with the New Jersey Environmental Clean-up Responsibility Act (ECRA), subsequently amended and replaced by the New Jersey Industrial Site Recovery Act (ISRA) in 1993, herein referred to as ECRA/ISRA. The results of the investigation showed that soil and groundwater had been impacted by VOCs, primarily chlorinated solvents.

In October 1997, The BOC Group, Inc. (now Messer, LLC), filed a Memorandum of Agreement (MOA) with NJDEP to investigate and remediate the source(s) of VOC impacts to the groundwater related to what is now known as the Messer Property. Pursuant to the MOA, a Preliminary Assessment (PA) was conducted in 1998 at the Messer Property to identify the presence of potentially contaminated areas. The areas that were evaluated included potential source areas including aboveground tanks and associated piping, underground storage tanks (UST) and associated piping, sumps, pits, storage pads, dumpsters, chemical storage cabinets, floor drains, roof leaders, drainage swales, storm sewers, culverts, septic systems, electrical transformers, spill areas, boiler room, hazardous material storage areas, and cleaning areas.

Based on a detailed review of operations that were conducted at the Messer Property, the following Areas of Concern (AOCs) were identified and further investigated following the PA under NJDEP oversight.

- BOC AOC-1 Cylinder Preparation Area
- BOC AOC-2 Former Cylinder Preparation Area
- BOC AOC-3 Vicinity of AFGMW-14 (Railroad Spur)
- BOC AOC-4 Former Septic System
- BOC AOC-5 Former Radioactive Gases Facility
- BOC AOC-6 Former UST
- BOC AOC-7 Outfall from Stormwater Pipes
- BOC AOC-8 AFG Butler Building Area

Each AOC was investigated during the 1999 Remedial Investigation (RI). Soil and groundwater (and surface water or sediment where applicable) were collected to characterize the potential contamination at each AOC. The results showed that AOC-2, AOC-3, and AOC-6 were potential sources of groundwater contamination. AOC-1, AOC-4, AOC-5, and AOC-7 were granted No Further Action (NFA) approvals by the NJDEP. BOC AOC-8, the AFG Butler Building Area, was added to the list of AOCs after samples collected near this area showed potential impacts to soil and groundwater.

In 2008, EPA and Messer's predecessor, Linde Inc., entered into an Administrative Settlement Agreement and Order on Consent for the performance of a Remedial Investigation/Feasibility Study for OU3 (OU3 RI/FS) and a removal action. The RI/FS was conducted to determine the nature and extent of soil, surface water, sediment and groundwater contamination that is located on or migrating from the Messer Property and the removal action includes addressing contaminated soil. The results of prior sampling data, as well as RI investigations conducted during the OU3 RI/FS, showed that groundwater is impacted by VOCs, primarily chlorinated solvents including trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (VC). TCE, cis-1,2-DCE, and VC were consistently detected in groundwater samples. The distribution of the VOCs shows source(s) of VOCs in OU3, and groundwater containing VOCs flows both to the northwest (beneath Inman Street, Kern Street, and Zeisner Street in Cinnaminson) where it potentially discharges to the Delaware River and to the southeast where it mixes with VOCs from OU1 and other potential sources. Groundwater contamination migrating northwest is being addressed as part of OU3, while groundwater contamination migrating from the Messer Property to the southeast is included as part of OU4.

In conjunction with the OU3 RI/FS, EPA is conducting a VI investigation of nearby residential properties that has been ongoing since March 2009. To date, EPA has tested 73 homes/businesses and has installed 13 mitigation systems to protect indoor air.

In 2009, EPA also conducted a VI study of a neighborhood to the south of the Messer Property, located near the Detrex Corporation (Detrex) property. There were no issues found with vapor intrusion in buildings located in this neighborhood.

OPERABLE UNITS AND CONTAMINANT SOURCES

OU1

The two SLI Landfills, originally owned by Lockhart Construction Company, were originally operated as sand and gravel mines. The mining operations were terminated in the late 1960s and later landfilling operations began. The landfills were closed and capped in 1987.

The OU1 RI/FS was performed by EPA from 1985 to 1989. The study primarily focused on groundwater contamination emanating from the two former SLI Landfills.

In September 1990, EPA issued the OU1 ROD. The selected remedy included the following actions:

- extraction and treatment of contaminated groundwater primarily emanating from the SLI Landfills;
- reinjection of the treated groundwater; and
- installation and monitoring of additional wells to ensure the effectiveness of the remedy.

SLI completed the remedial design. After the design was completed, construction of the treatment plant and installation of the extraction, treatment, and reinjection system was completed in May 2003.

In May 2013, SC Holdings, Inc. (SCH) a wholly owned subsidiary of Waste Management, Inc. and the current owner of the SLI Landfills (SLI merged with SCH in 1993), submitted a request to perform a "pump and treat system monitoring assessment/shutdown test" (also known as a Shutdown Study) since groundwater quality had improved. The purpose of the two-year Shutdown Study was to evaluate if the groundwater would be re-contaminated if the treatment plant operation was temporarily shut down. EPA reviewed and evaluated the results of the two-year Shutdown Study. As a result, in 2016, a long-term monitoring plan (LTMP) was developed to monitor groundwater to ensure contaminant levels continue to improve. This LTMP will continue while the temporary shutdown remains in place.

OU2

OU2 addressed the source area contamination at the SLI Landfills. Landfill caps had been constructed in 1987 pursuant to a NJDEP Administrative Consent Order (ACO), dated October 1984.

After SCH's design, construction and monitoring of an enhanced landfill gas management system and drainage improvements, the OU2 ROD was issued in July 2014. The ROD determined that no further remedial action was necessary for OU2 to ensure protection of human health and the environment. SCH maintains the landfill caps with oversight by the regulatory agencies.

OU3 – See description above.

OU4

OU4 addresses groundwater contamination within the Site that is not currently being addressed by OU1, OU2, or OU3. The SLI Landfills (OU1 and OU2), the Messer Property and the Detrex property are the primary identified sources of the OU4 groundwater contamination.

A brief description is provided above for the SLI Landfills and the Messer Property and below for additional source area.

<u>Detrex Corporation</u>

The Detrex property at 835 Industrial Highway, Cinnaminson, New Jersey began operations in 1972 as a storage, distribution, and transportation facility for solvents used in degreasers within an 8,000 square foot leasehold of the property. Solvents and a transfer facility for wastes containing chlorinated solvents, including tetrachloroethene (PCE), degreasers including PCE, TCE, 1,1,1-trichloroethane (1,1,1-TCA), methylene chloride, and trichlorotrifluoroethane were handled at this facility. By 1990, Detrex handled wastes containing polychlorinated biphenyls (PCBs), herbicides, and other chemicals.

Multiple investigations have been performed under NJDEP oversight at the Detrex property since July 2001. These results show there is an uncontrolled release of TCE, as well as other contaminants, at the Detrex property impacting on-property soil and groundwater, downgradient groundwater, and downgradient soil gas.

<u>Sea Box Landfill</u>

The Sea Box Landfill (formerly owned by the Hoeganaes Corporation and now owned by 1001 Taylors Lane LLC, a subsidiary of Sea Box, Inc.) is located between the intersection of River Road and the Union Landing Road, and the Delaware River. The approximate 400 feet by 2,300 feet (35 acres) landfill was constructed on land surface and partially on Delaware River dredge spoils material. The material disposed of reportedly consisted of wastes comprised of coke/lime dust/slurry, iron dust/oxide powder, electric arc furnace (EAF) dust, and slag.

TCE has been detected in groundwater samples collected at the Sea Box landfill since 1984. The highest TCE concentration of 130 micrograms per liter (µg/l) (November 1988) was detected in a monitoring well located along the southern property line of the landfill. Groundwater samples collected by Linde, Inc. in 2004 show that TCE was not detected from a groundwater sample collected at the water table and TCE was detected at 120 µg/l in a groundwater sample collected from a zone above the clayey saprolite. TCE was recently detected in groundwater samples collected from monitoring wells on the Sea Box Landfill property at concentrations ranging from below the limit of detection to 36 µg/l.

Very low concentrations of VOC contamination occur in groundwater at this landfill; therefore, it was not found to be as a significant source of OU4 groundwater contamination as compared to the Messer and Detrex properties and SLI Landfills.

SITE CHARACTERISTICS FOR OU3

Physical Setting

The population of Cinnaminson is approximately 16,350 as of the 2019 census. Land use in the vicinity of OU3 consists of small to large industrial properties, commercial lots, and residential properties. The former Hoeganaes Corporation industrial property is located to the northeast of OU3 and its former landfill (the Sea Box Landfill) is located between the intersection of River Road and Union Landing Road and the Delaware River. Several small industrial properties are located to the southeast of OU3, beyond which are the SLI Landfills. Residential properties are located northwest of River Road and southwest of Union Landing Road. The New Jersey Transit River line light rail runs along River Road. The highest elevation in OU3 is approximately 20 feet above mean sea level (msl) with land surface sloping towards the Delaware River (approximately 5 feet above msl). Overland runoff during precipitation events is generally directed to the Delaware River.

Site Geology/Hydrogeology

The Site is located within the Atlantic Coastal Plain physiographic province of New Jersey, characterized by sequences of southeasterly dipping marine and terrestrial deposits of Cretaceous to Holocene age. These unconsolidated sediments thicken from the Delaware River toward the Atlantic Ocean. The Coastal Plain sediments are composed of sand, gravel, silt, and clay and are underlain by bedrock formations of Paleozoic and Pre-Cambrian ages. The bedrock consists primarily of crystalline schist, basalt, and gneiss of Precambrian to Paleozoic age with local occurrences of sandstone and shale.

Most of OU3 is underlain by the Pennsauken Formation. The thickness of the Pennsauken Formation ranges from a few feet to approximately 30 feet along Union Landing Road. The Pennsauken Formation overlies the Wissahickon Formation (bedrock). The southern and eastern portions of OU3 are underlain by the Potomac, Raritan, and Magothy (PRM) Formation which overlies the Wissahickon Formation (bedrock). The PRM Formation forms a southeasterly sloping wedge of sediments that extend from land surface to over 150 feet deep at the downgradient southwest end of OU3.

Hydrogeology

The two unconsolidated geologic formations described above, PRM and Pennsauken, are water-saturated, thus forming one hydraulically

connected aquifer called the PRM/Pennsauken aquifer. Groundwater level measurements and the distribution of groundwater contaminants show groundwater in the Pennsauken and PRM Formations are hydraulically connected allowing groundwater and groundwater contaminants to migrate from the Pennsauken Formation into the PRM Formation.
NJDEP classifies the PRM/Pennsauken aquifer as Class IIa, meaning it is a potential drinking water aquifer and/or is currently used as a drinking water supply. The PRM/Pennsauken aquifer is designated as NJDEP Water Supply Critical Area II, meaning that the amount of groundwater that can be withdrawn is regulated by the NJDEP due to over-pumping of the aquifer in the area for municipal, commercial and agricultural purposes.

The impact of the over-pumping is apparent considering that the natural hydraulic gradient within the Site was historically from southeast to northwest with groundwater ultimately discharging to the Delaware River. This is evident from the USGS's pre-pumping groundwater potentiometric surface map from 1900. However, groundwater pumping in the area has reversed the natural groundwater flow direction in the southwestern portion of OU3, causing groundwater in this area to migrate predominately from the northwest to the southeast towards municipal, industrial and irrigation wells as indicated in water elevations collected during the OU4 RI.

Surface Water

OU3 lies within the drainage basin of the Delaware River. The Delaware River is located approximately 2,000 ft northwest of OU3 and is the primary surface water feature in the area. The Delaware River flows in a southwesterly direction and is tidally influenced in the Cinnaminson area.

There are no natural surface water features in OU3. The closest mapped surface water features are an unnamed tributary of the Delaware River on the side of River Road, near the northern corner of OU3, and an unnamed tributary of Swede's Run (the perimeter stormwater collection ditch for the SLI Northwest Landfill). The unnamed tributary of Swede's Run does not receive surface water runoff from OU3 because it is hydrologically upgradient of OU3.

SUMMARY OF THE OU3 REMEDIAL INVESTIGATION

The OU3 RI included the following work:

Soil Borings and Soil Sampling

Building on the work done under the MOA with NJDEP, twenty-seven soil borings were advanced to further delineate VOC contamination in the Former Cylinder Preparation Area (AOC-2), Railroad Spur (AOC-3), Former Heating Oil UST (AOC-6), Butler Building Area (AOC-8), and other areas in OU3. Soil samples were collected from each boring using direct-push techniques (i.e., Geoprobe). Each soil sample was screened using a photoionization detector. Soil displaying the highest concentration of vapors were sampled using an EnCore ® sampling device for VOC laboratory analysis.

Monitoring Well Installation

Fifteen monitoring wells were installed to further evaluate groundwater flow and groundwater quality in OU3 and in the residential area north of Union Landing Road and to achieve a better understanding of whether groundwater contamination impacted the deep bedrock zone.

Groundwater Sampling

Groundwater samples were collected during multiple events from 2015 to 2020. During the most recent sampling event (December 2020), groundwater samples were collected from 50 monitoring wells (including the 15 newly installed wells) and analyzed for Target Compound List (TCL) VOCs, inorganics and 1,4-dioxane to further characterize the nature and extent of groundwater contamination. As part of the December 2020 sampling event, samples were collected at or near low tide and high tide from five surface water locations and four monitoring well locations to evaluate potential tidal influences on groundwater-surface water interaction.

Surface Water Sampling

Surface water samples were collected from five locations (SW-01 through SW-05) within the unnamed tributary of the Delaware River and analyzed for TCL VOCs and 1,4-dioxane to determine if OU3 groundwater contamination is discharging to surface water.

Vapor Intrusion Sampling

Soil vapor samples were collected by Messer and analyzed for VOCs to determine if VOCs exist in the soil gas beneath the buildings at the Messer Property at concentrations that have the potential to impact indoor air quality within the buildings. Sub-slab soil gas samples were also collected in conjunction with ambient outdoor air and indoor air samples to determine if the potential exposure pathway to on-property industrial workers/nearby residents via soil VI into building interiors is complete. The ambient air samples were collected as 24-hour composite samples from a centrally located area in OU3.

In addition, EPA collected sub-slab soil gas and indoor air samples in a total of 73 structures located hydraulically downgradient from the OU3 groundwater contamination source areas and installed mitigation systems in 13 structures (i.e., properties northwest of River Road and southwest of Union Landing Road).

NATURE AND EXTENT OF CONTAMINATION

Soil Sampling Results

Volatile Organic Compounds

Soil samples collected during the OU3 RI were analyzed for VOCs and the data were evaluated along with historic soil sampling data to further define the soil remediation areas. The OU3 RI results (and historic sampling) show there are three primary source areas of TCE on the Messer Property:

- the Former Cylinder Preparation Area (AOC-2),
- the Railroad Spur Area (AOC-3), and
- the Butler Building Area (AOC-8).

Former Cylinder Preparation Source Area

Historic and OU3 RI soil samples collected from the Former Cylinder Preparation Area (which has previously undergone remediation by soil vapor extraction (SVE)) show the vadose zone between 0 and 2 feet below ground surface (bgs) contains TCE at levels above the site-specific screening levels (SSLs). TCE was also detected at levels above the SSLs in the smear zone (a transitional zone between unsaturated and saturated soils), between 6.5 and 10 feet bgs. TCE did not exceed the SSLs in soil samples collected from the saprolite above bedrock, which is 15 feet below the ground surface.

Butler Building Source Area

Historic and OU3 RI soil samples collected from the Butler Building Area show the vadose zone between 0 and 2 feet bgs contains TCE at levels above the SSLs at two locations. TCE was also detected at levels above the SSLs in the smear zone and in the saprolite above bedrock.

Railroad Spur Source Area

Historic and OU3 RI soil samples collected from the Railroad Spur Area show the vadose between 0 and 2 feet bgs does not contain TCE at levels above the SSLs. TCE was detected at levels above the SSLs in the smear zone and in the saprolite above bedrock.

Semi-Volatile Organic Compounds

Historic and recent soil samples collected from the Messer Property show SVOCs were detected in soil at levels above the SSLs. The SVOCs detected are likely from anthropogenic sources, such as asphalt, and not related to activities at the Messer Property.

Metals

Historic and recent soil samples collected from OU3 show metals including arsenic, cadmium, lead, and mercury were detected at levels in soil above the SSLs. The metals detected in soils are likely the result of urban fill and/or historic fill and not related to activities at the Messer Property.

Total PCBs

Historic and recent soil samples collected from the Messer Property show site-related PCBs in soil at concentrations above the SSLs in two samples.

Pesticides

Historic and recent soil samples collected from the Messer Property show pesticides were not detected at levels above the SSLs in soil samples.

Groundwater Sample Results

Former Cylinder Preparation Area

Groundwater samples were collected in May and October 2015 and December 2020 during the OU3 RI. The results are summarized below:

- PCE was detected in exceedance of the SSL (1 µg/L) at AFGMW-23 (1.2-1.3 µg/L).
- TCE was detected in exceedance of the SSL (1 µg/L) at AFGMW-10 (4-13 µg/L), AFGMW-11 (1.9 µg/L), AFGMW-23 (44-75.6 µg/L), and BOCMW-2 (13-93 µg/L).
- Cis-1,2-DCE was detected in exceedance of the SSL (70 µg/L) at AFGMW-23 (127 µg/L) and BOCMW-2 (360-463 µg/L).
- VC was detected in exceedance of the SSL (1 µg/L) at AFGMW-23 (1.7-6.3 µg/L) and BOCMW-2 (7.1-79.9 µg/L).
- Benzene was detected in exceedance of the SSL (1 µg/L) at BOCMW-2 (1.3 µg/L).
- 1,1-Dichloroethene was detected in exceedance of the SSL (1 µg/L) at BOCMW-2 (1.3 µg/L).

Railroad Spur Area

Groundwater samples were collected in October 2015 and December 2020 during the OU3 RI. The results are summarized below:

- TCE was detected in exceedance of the SSL (1 µg/L) at AFGMW-14 (26.5-43 µg/L), and AFGMW-16 (45.2-82 µg/L).
- Cis-1,2-DCE was detected in exceedance of the SSL (70 µg/L) at AFGMW-14 (148-230 µg/L).
- VC was detected in exceedance of the SSL (1 µg/L) at AFGMW-14 (56-68.8 µg/L), and AFGMW-16 (2.2 µg/L).
- 1,1-Dichloroethene was detected in exceedance of the SSL (1 µg/L) at AFGMW-14 (1.1 µg/L).

Butler Building Area

Groundwater samples were collected in October 2015, August 2016, and December 2020 during the OU3 RI. The results are summarized below:

- TCE was detected in exceedance of the SSL (1 µg/L) at AFGMW-21R (7.9-3,010 µg/L), DW-01 (1.4 µg/L), and PZ-A2 (93 µg/L).
- Cis-1,2-DCE was detected in exceedance of the SSL (70 µg/L) at AFGMW-21R (84.7 µg/L).

Residential Area North of River Road

Groundwater monitoring well samples were collected in October 2015, August 2016, and December 2020 during the OU3 RI. The results are summarized below:

- TCE was detected in exceedance of the SSL (1 µg/L) at BOCMW-7 (7.2-24 µg/L), BOCMW-8 (3.8-27 µg/L), BOCMW-9 (1.8-2.5 µg/L), BOCMW-10 (21-70 µg/L), BOCMW-11 (19-57.3 µg/L), BOCMW-12 (56.4-64 µg/L), BOCMW-16 (35.4-97 µg/L).
- Cis-1,2-DCE was detected in exceedance of the SSL (70 µg/L) at BOCMW-7 (80 µg/L).
- VC was detected in exceedance of the SSL (1 µg/L) at BOCMW-8 (1.4 µg/L), BOCMW-12 (3.2 µg/L).

OU3 Non-Source Areas (Areas in OU3 that are not included in the Former Cylinder Area, Railroad Spur Area, and Butler Building Area)

Groundwater samples were collected in October 2015, August 2016, and December 2020 during the OU3 RI. The results are summarized below:

- TCE was detected in exceedance of the SSL (1 µg/L) at 27 wells ranging in concentration from 1.1 µg/L to 200 ug/L.
- Cis-1,2-DCE was detected in exceedance of the SSL (70 µg/L) at SL-4D (114-200 µg/L).
- VC was detected in exceedance of the SSL (1 µg/L) at temporary well B-142 (4.4 µg/L) and at BOCMW-3 (2.7 µg/L).
- PCE was detected in exceedance of the SSL (1 µg/L) at SL-4D (1.7-2.5 µg/L).
- 1,1-Dichloroethene was detected in exceedance of the SSL (1 µg/L) at SL-4D (1.6 µg/L).
- Benzene was detected in exceedance of the SSL (1 µg/L) at AFGMW-7 (1.4 µg/L) and at PT-5D (2.6 µg/L).

Vapor Intrusion

- Sub-slab soil gas samples were collected on the Messer Property in August 2016. TCE was detected at a concentration exceeding the SSL of 99.7 micrograms per cubic meter [$\mu g/m^3$]) in SS-7 at the guard shack on the Sea Box portion of the Messer Property (sample concentration of 320 $\mu g/m^3$).
- An indoor air sample was collected from within the guard shack building on the Sea Box portion of the Messer Property on April 14, 2017. There were no exceedances of the indoor air SSLs.

Surface Water Sampling (2020)

As part of the OU3 RI, surface water samples were collected from the unnamed tributary to the Delaware River for laboratory analysis of VOCs and 1,4-dioxane.

- TCE was detected in exceedance of the SSL (1 µg/L) at SW-03 (0.98 J and 6 µg/L at high tide and low tide, respectively) and SW-04 (1.3 µg/L at low tide).

- Cis-1,2-DCE was detected in exceedance of the SSL (1 µg/L) at SW-03 (1.4 µg/L at low tide).

TCE was detected in SW-05 (estimated 0.56 µg/L at low tide only) below the SSL. These results show that VOC concentrations are consistently higher during low tide compared to high tide. This indicates groundwater impacted by VOCs is likely discharging to surface water of the unnamed tributary, which is diluted by the component of surface water encroaching from the Delaware River.

1,4-dioxane was detected in surface water samples at four locations. 1,4-dioxane was detected only during high tide at SW-01 and SW-02 (0.209 and 0.32 µg/L, respectively). 1,4-dioxane was detected in the samples collected during high tide at SW-04 and SW-05 (0.291 and 0.237 µg/L, respectively) and low tide (0.175 and 0.133 µg/L, respectively). These results show that 1,4-dioxane concentrations are consistently higher during high tide compared to low tide indicating it is likely that contributions of 1,4-dioxane to surface water may be entering the unnamed tributary from the Delaware River.

OU3 Major Conclusions

- VOCs were released to the unconsolidated soils at the three identified source areas on the Messer Property during past operations at the property and have impacted underlying groundwater. The three primary source areas are: the Former Cylinder Preparation Area (AOC-2), the Railroad Spur Area (AOC-3), and the Butler Building Area (AOC-8).
- Groundwater in the Pennsauken/PRM aquifer historically flowed to the northwest discharging to the Delaware River. However, pumping of groundwater by municipal, industrial, and irrigation wells has reversed the groundwater flow direction on the southeastern portion of OU3 where groundwater is now flowing to the southeast. This is addressed in the OU4 remedy.
- Groundwater containing elevated VOC contamination migrates from the Railroad Spur Area and the Butler Building Area of the Messer Property to the north, potentially discharging to an inlet of the Delaware River.
- Groundwater containing elevated VOC contamination migrates from the Former Cylinder Preparation Area of the Messer Property to the southwest, potentially combining with other off-property groundwater contamination, and further migrating to the southeast.
- Surface water, in the unnamed tributary of the Delaware River, contains VOCs above SSLs.
- VI potential into residential and commercial structures downgradient from OU3 source areas exists due to the concentration of OU3-related VOC contamination in groundwater.

RISK SUMMARY

As part of the OU3 RI/FS, a baseline risk assessment was conducted to estimate the current and future effects of contaminants on human health and the environment. A baseline risk assessment is an analysis of the potential adverse human health and ecological effects caused by hazardous substance exposures in the absence of any actions to control or mitigate these exposures under current and future site uses. The baseline risk assessment includes a human health risk assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA).

In the HHRA, cancer risk and noncancer health hazard estimates are based on current reasonable maximum exposure (RME) scenarios. The estimates were developed by taking into account various health protective estimates about the concentrations, frequency and duration of an individual's exposure to chemicals selected as contaminants of potential concerns (COPCs), as well as the toxicity of these contaminants.

Human Health Risk Assessment

A four-step human health risk assessment process was used for assessing OU3-related cancer risks and noncancer health hazards. The four-step process is comprised of Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (see adjoining box "What is Risk and How is it Calculated").

The HHRA began with selecting COPCs in various media (i.e., groundwater, surface soil, subsurface soil, and surface water) that could potentially cause adverse effects in exposed populations. COPCs were selected by comparing the maximum detected concentrations of the contaminants identified with state and federal risk-based screening values. The screening of each COPC was conducted separately for each medium of interest. The COPCs identified in groundwater underlying the Messer Property were aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, selenium, vanadium, benzo(a)anthracene, benzo(b)fluoranthene, naphthalene, benzene, cis-1,2-DCE, TCE, and vinyl chloride (VC); the COPCs identified in groundwater off the Messer Property were aluminum, arsenic, chromium, cobalt, iron, manganese, vanadium, cis-1,2-DCE, TCE, and VC. Certain metals, polycyclic aromatic hydrocarbons (PAHs), PCBs, and VOCs were identified as surface soil and subsurface soil

WHAT IS RISK AND HOW IS IT CALCULATED?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Step 1. Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (i.e., soil, groundwater, surface water, and air) are identified 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.

Step 2. Exposure Assessment: In this step, the different 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 and/or groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

Step 3. Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures, and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health hazards, 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 noncancer health hazards.

Step 4. Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all contaminants of concern. Exposures are evaluated based on the potential risk of developing cancer and the potential for noncancer 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 may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one in ten thousand to a one in a million excess cancer risk. For noncancer health effects, a "hazard index" (HI) is calculated. The key concept for a noncancer HI is that a "threshold" (measured as an HI of less than or equal to 1) exists below which noncancer health hazards are not expected to occur. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. Chemicals that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at the site.

COPCs. TCE was also identified as a COPC in surface water. All identified COPCs can be found in the HHRA, and the identified COPCs were evaluated further in the risk assessment. In addition, the potential for subsurface vapor intrusion into indoor air was evaluated for

structures both on and off the Messer Property in OU3.

Based on the current zoning and land use on and near the Site, the HHRA evaluated residential, commercial, and construction exposure to OU3 contamination. The exposure assessment identified potential human receptors based on a review of current and reasonably foreseeable future land use at the Messer Property, which includes the child and adult residents, commercial/industrial workers, and construction workers. Two separate exposure areas were evaluated for potential receptor exposure to groundwater affected by the Messer Property. The first exposure area includes groundwater analytical results from monitoring wells located within the Messer Property. Surface and subsurface soil within the source areas on the Messer Property is also included within this exposure area. The second exposure area consists of groundwater analytical results from monitoring wells north/northwest of the of the Messer Property, within a residential neighborhood. Surface water sample results from an unnamed tributary were also included in this exposure area.

Potential Exposure Pathways

The current and future land use scenarios evaluated in the HHRA included the following exposure pathways and populations:

- Residents (child [0-6 years] and adults): incidental ingestion of soil, dermal contact with soil, and inhalation of contaminants absorbed to windblown soil; ingestion of and dermal contact with groundwater; inhalation exposures due to potential volatilization of VOCs during showering/bathing; ingestion of and dermal contact with surface water in unnamed tributary and inhalation of VOCs in indoor air via vapor intrusion
- Construction worker (adults): incidental ingestion of soil, dermal contact with soil, and inhalation of contaminants absorbed to windblown soil; and ingestion of and dermal contact with groundwater and inhalation of VOCs in the air of a trench
- Commercial worker (adults): incidental ingestion of soil, dermal contact with soil, and inhalation of contaminants absorbed to windblown soil; ingestion of and dermal contact with groundwater; and inhalation exposures due to potential volatilization of VOCs during showering/ bathing, dish washing, flushing of toilets, and other activities that require the use of tap water; and inhalation of VOCs in indoor air via vapor intrusion

A complete summary of all exposure scenarios can be found in the baseline HHRA.

Contaminant Exposure Evaluation Process

In this assessment, exposure point concentrations (EPC) were estimated using either the maximum detected concentration of a contaminant or the 95% upper-confidence limit (UCL) of the average concentration. Chronic daily intakes were calculated based on RME, which is the highest exposure reasonably anticipated to occur at OU3. The RME is intended to estimate a conservative exposure scenario that is still within the range of possible exposures.

Summary of the Human Health Risk Characterization

In the risk assessment, two types of toxic health effects were evaluated for COPCs: cancer risk and noncancer hazard. Calculated cancer risk estimates for each receptor were compared to EPA's target risk range of $1x10^{-6}$ (one-in-one million) to $1x10^{-4}$ (one-in-ten thousand). The calculated noncancer hazard index (HI) estimates were compared to EPA's target threshold value of 1. The following sections provide an overview of the cancer risks and noncancer hazard estimates associated with exposure to the following media at OU3: groundwater, soil, and surface water. Exposure to lead and from subsurface vapor intrusion into indoor air (evaluated using indoor air and sub-slab soil gas data) for structures on the Messer Property as well as those located northwest of River Road and southwest of Union Landing Road are also discussed.

Groundwater

Risks and hazards were evaluated for current and future exposure to (1) source area groundwater (i.e., the Messer Property) and (2) groundwater located northwest of River Road. The summary of hazards and risks associated with these two groundwater exposure areas are listed in Table 1. The populations of interest included child and adult residents as well as commercial and construction workers.

Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk.

Messer Property (Source Areas)

The total non-carcinogenic HI for a child (365) and an adult resident (250) exposed to source area groundwater exceed the acceptable threshold of 1. The primary contributor to these exceedances was TCE, with smaller contributions from arsenic. The cumulative lifetime carcinogenic risk of $3x10^{-3}$ for the resident adult and child combined is above EPA's acceptable cancer risk range of 10^{-6} to 10^{-4} for groundwater. TCE in groundwater is the primary COPC contributing to the elevated cancer risk. In addition, arsenic, chromium, and VC also contributed to cumulative carcinogenic risks greater than 10^{-4}. However, it should be noted that total chromium was conservatively evaluated as hexavalent chromium in determining groundwater carcinogenic risks. If instead it was assumed that total chromium concentrations were in the trivalent form, chromium would not be retained as a COPC in groundwater. In addition, there is no documentation of hexavalent chromium being used in any of the former processes at the Messer Property, and elevated concentrations of arsenic in groundwater are limited in areal extent, likely caused by reducing conditions at the Messer Property and are consistent with regional background concentrations. Based on these considerations, which are further discussed in the OU3 RI and HHRA, EPA concluded that neither chromium nor arsenic should be considered OU3-related COPCs.

For construction workers, potential exposure to groundwater revealed non-carcinogenic hazards (80) above the acceptable level of 1 due to inhalation of TCE within a trench. For commercial workers, exposure to groundwater revealed non-carcinogenic hazards (21) above the acceptable level of 1 primarily due to TCE exposure. Carcinogenic risk for the commercial workers exposed to groundwater was equal to $3x10^{-4}$; TCE showed carcinogenic risks greater than 10^{-4} and arsenic, chromium, and VC showed carcinogenic risks greater than 10^{-5}.

Northwest of River Road

The total non-carcinogenic HI of 22 for a child and 15 for an adult resident exposed to groundwater northwest of River Road exceed the acceptable threshold of 1. The primary COPC contributing to this exceedance was TCE. In addition, arsenic had a hazard quotient

(HQ) greater than 1 for the child resident. Carcinogenic risks for exposure to groundwater northwest of River Road were equal to $1x10^{-3}$. The primary contributors to risk were arsenic, chromium, and VC with carcinogenic risks greater than 10^{-4}, and TCE had carcinogenic risk greater than 10^{-5}. As noted above, EPA does not consider chromium or arsenic to be COPCs for OU3 groundwater.

Table 1. Summary of hazards and risks associated with groundwater

Receptor	Hazard Index	Cancer Risk
Messer Property		
Child Resident	**365**	Not applicable[a]
Adult Resident	**250**	Not applicable[a]
Child and Adult Resident Combined	Not applicable	**3×10^{-3}**
Construction Worker	**80**	2×10^{-5}
Commercial Worker	**21**	**3×10^{-4}**
Northwest of River Road		
Child Resident	**22**	Not applicable[a]
Adult Resident	**15**	Not applicable[a]
Child and Adult Resident Combined	Not applicable	**1×10^{-3}**

Bold indicates value is above acceptable risk range or value.

[a] Carcinogenic risks for the child and adult are combined to represent cumulative lifetime carcinogenic risks. As a result, carcinogenic risks for the child and adult, individually, are not applicable.

Soil (surface and subsurface)

Risks and hazards were evaluated for current and future exposure to soil at the Messer Property, and the summary of hazards and risks associated with surface and subsurface soil are listed in Table 2. The populations of interest included child and adult residents as well as commercial and construction workers. The total non-carcinogenic HI of 3 for child resident exposure to surface soil exceeded the acceptable threshold of 1 but did not when broken down by target organ/effect for OU3-related contaminants. Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. The cumulative lifetime carcinogenic risk for the child and adult resident combined (2×10^{-4}) is above EPA's acceptable cancer risk range of 10^{-6} to 10^{-4} for surface soil. The COPCs contributing the majority of the elevated cancer risk were chromium and PAHs, but EPA does not consider these contaminants to be OU3-related.

Table 2. Summary of hazards and risks associated with surface and subsurface soil

Receptor	Hazard Index	Cancer Risk
Surface soil		
Child Resident	3[b]	Not applicable[a]
Adult Resident	1	Not applicable[a]
Child and Adult Resident Combined	Not applicable	**2×10^{-4}**
Construction Worker	0.5	1×10^{-6}
Commercial Worker	0.4	1×10^{-5}
Subsurface soil		
Child Resident	1	Not applicable[a]
Adult Resident	0.8	Not applicable[a]
Child and Adult Resident Combined	Not applicable	7×10^{-5}
Construction	0.2	6×10^{-7}

Receptor	Hazard Index	Cancer Risk
Worker		

*Bold indicates value above the acceptable risk range or value
[a]Carcinogenic risks for the child and adult are combined to represent cumulative lifetime carcinogenic risks. As a result, carcinogenic risks for the child and adult, individually, are not applicable.
[b]The noncarcinogenic hazard does not exceed 1 based upon a breakdown by target organ/effect for OU3-related constituents.

Surface Water

Cancer risks and noncancer hazards were evaluated for future child and adult residents exposed to surface water in an unnamed tributary located near the Site. Carcinogenic risks for the resident adult and child are combined to account for an excess, lifetime cumulative carcinogenic risk. A summary of hazards and risks associated with surface water are shown in Table 3. Carcinogenic risks and non-carcinogenic hazards for exposure to surface water were within EPA's acceptable levels.

Table 3. Summary of hazards and risks associated with surface water

Receptor	**Hazard Index**	**Cancer Risk**
Child Resident	0.01	Not applicable[a]
Adult Resident	0.004	Not applicable[a]
Adult and Child Resident Combined	Not applicable	7×10^{-8}

[a]Carcinogenic risks for the child and adult are combined to represent cumulative lifetime carcinogenic risks. As a result, carcinogenic risks for the child and adult, individually, are not applicable.

Lead Evaluation

Lead was identified as a COPC in subsurface soil on the Messer Property based upon a comparison of the maximum detected concentration of 227 mg/kg to the residential-based soil screening level of 200 mg/kg. Since there are no published quantitative toxicity values for lead, it was not possible to evaluate cancer and non-cancer risk estimates from lead using the same methodology as the other COPCs. Consistent with EPA guidance, exposure to lead was evaluated separately from the other contaminants using blood lead modeling. Lead was evaluated for the residential scenario with the EPA IEUBK model. Potential concerns for workers were evaluated with the EPA Adult Lead Model. Both models evaluate the percentage (%) of a target population that will have blood-lead levels above the reference concentration of 5 µg /dL. The risk reduction goal for lead in soils at the Messer Property is to limit the probability of a child's or developing fetus' blood lead level from exceeding 5 micrograms per deciliter (µg/dL) to 5% or less. Both the IEUBK and the Adult Lead Model reveal blood-lead below the threshold value of 5% exceeding a reference blood lead level of 5 µg /dL as shown in Table 4.

Table 4. Lead evaluation at Messer Property

Reference Blood-lead Level	**5 µg /dL**	
	% Exceeding	**Mean Blood-lead Level (µg /dL)**
IEUBK Model	0.205	1.3
Adult Lead Model	0.024	1.7

Vapor Intrusion

A vapor intrusion investigation was conducted to assess the potential migration of VOC contaminated vapors into indoor air at and near the Messer Property. Vapor intrusion samples (indoor air and sub-slab soil gas) were collected for buildings on the Messer Property as well as structures located hydraulically downgradient of the Messer Property (i.e., northwest of River Road and southwest of Union Landing Road).

All vapor intrusion data were compared to the appropriate exposure scenario (either residential or commercial), EPA vapor intrusion screening levels (VISLs) based on a cancer risk of $1x10^{-6}$ and a hazard quotient of 1. Although all contaminants detected in air samples are screened against VISLs, the discussion of vapor intrusion results below focuses only on the detected volatile contaminants suspected to be OU3-related.

Indoor Air

Prior to mitigation systems being installed, TCE exceeded the current EPA residential non-cancer indoor air VISL of 2.1 $\mu g/m^3$ at 13 residential locations. TCE exceeded the EPA commercial non-cancer indoor air VISL of 8.8 $\mu g/m^3$ at 4 of these residential locations.

Sub-Slab Soil Gas

TCE exceeded the current EPA residential non-cancer sub-slab soil VISL of 70 $\mu g/m^3$ in the following structures: Units 09, 22, 68, and 69. TCE exceeded the current EPA commercial non-cancer based sub-slab VISL of 290 $\mu g/m^3$in unit 22.

Human Health Risk Assessment Summary

In conclusion, all potential receptors' exposures to groundwater had non-cancer hazards that exceed EPA's acceptable threshold of 1, primarily due to the presence of TCE. Carcinogenic risk results were above the EPA acceptable risk range for the groundwater on the Messer Property as well as for groundwater that has migrated off the Messer Property. TCE was the primary COPC contributing to elevated carcinogenic risks for direct contact with groundwater and also for inhalation of VOCs in indoor air. Additionally, VC also contributed to carcinogenic risk concerns for direct contact exposure to groundwater. Arsenic and total chromium evaluated as hexavalent chromium also contributed to cumulative carcinogenic risk concerns for groundwater; however, as previously discussed, EPA does not consider these metals to be OU3-related.

The total non-cancer HI for child resident exposure to surface soil exceeded the acceptable threshold of 1 but did not exceed the threshold when breakdown by target organ/effect for OU3-related contaminants. For surface soil exposure, cancer risks were above the EPA acceptable risk range driven by the presence of chromium and PAHs. However, it should be noted that the total chromium sample results were evaluated as the more toxic hexavalent chromium form, and EPA does not consider either chromium or PAHs to be OU3-related. The former operations at the Messer Property reportedly did not use hexavalent chromium in any of its processes; therefore, EPA does not consider chromium to be OU3-related. Soil risks from OU3-related contaminants were below EPA's thresholds and pose no unacceptable risk.

There were no exceedances of the cancer risks or non-cancer hazards from exposure to surface water for any of the receptors evaluated.

Exceedances of indoor air and/or sub-slab soil gas VISLs for TCE were found in and/or under several structures sampled and indicate that the potential for subsurface vapor intrusion into indoor air at the Messer Property exists.

Ecological Risk Assessment

A screening-level ecological risk assessment (SLERA) was conducted to evaluate the potential for ecological risks from the presence of contaminants in surface soil and groundwater. The SLERA focused on evaluating the potential for impacts to sensitive ecological receptors to OU3-related contaminants of potential ecological concern (COPECs) through exposure to surface soil (surface and up to 2 feet bgs) and groundwater on the Messer Property. For a receptor to be exposed to an OU3-related constituent, that receptor would have to be able to come into direct contact with the soil or soil particles that had transported from the Messer Property. Since there are no groundwater discharge points (springs or seeps) on the Messer Property, and surface water does not persist in the stormwater management basins or in the stormwater conveyance ditches on the Messer Property, exposure to COPECs in groundwater by ecological receptors is not possible. However, the groundwater exposure pathway has been retained and conservatively evaluated as a potential pathway for exposure to surface water by ecological receptors. A complete summary of all exposure scenarios can be found in the SLERA.

The following threatened and endangered species have been identified at OU3: bald eagle (Haliaeetus leucocephalus), Cooper's hawk (Accipiter cooperi), and red-shouldered hawk (Buteo lineatus). However, it would be unlikely that either a bald eagle or red-shouldered hawk would nest or attempt to forage on the OU3 area of the Site given the size, age, species composition, and level of human activity that surrounds the forest patches present onsite. The endangered species, Shortnose sturgeon (Acipenser brevirostrum) and Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus), also occur in the Delaware River. The habitat present on the Messer Property can support terrestrial invertebrates, small mammals, passerine bird species, and potentially larger transient wildlife species (e.g., turkey, whitetail deer [Odocoileus virginianus]). The limited occurrence, in terms of size, quality, and isolated (i.e., no vegetated corridors connecting it to larger natural habitat areas) nature of the quasi-natural habitat on the Messer Property severely limits its usefulness to all but those wildlife species that have adapted to utilizing habitat in close proximity to humans. Wildlife utilization of the Messer Property is limited because it is an active industrial property, and it is predominantly surrounded by chain-link fence and other commercial and residential land uses. Although there is potential for wildlife to use the natural areas on the Messer Property, those areas are not located where COPECs have been detected. Therefore, the only potential receptors would be areas located off the Messer Property where COPECs could be transported from stormwater discharges or in areas where groundwater could discharge to a surface waterbody. As previously discussed, there are no impacts from stormwater discharges on the Messer Property and the contaminated deep groundwater is not impacting the surface water northwest of River Road.

Surface Soil

The 95% Upper Confidence Limits (UCLs) of surface soil samples were compared to relevant ecological risk screening values, including NJDEP's Ecological Screening Criteria (2009) and National Oceanic and Atmospheric Administration's Screening Quick Reference Tables (2008). The following COPECs had an hazard quotient (HQ) that exceeded the threshold of 1: SVOCs (di-n-butyl phthalate, naphthalene); PCBs; pesticides (4,4'-DDT, 4,4'-DDD, 4,4'-DDE); and metals (aluminum, barium, cadmium, cobalt, manganese, selenium, thallium, and vanadium).

Groundwater

The 95% UCLs of groundwater samples were compared to relevant ecological risk screening values for surface water, including NJDEP's Ecological Screening Criteria (2009) for freshwater, which are New Jersey's Surface Water Quality Standards (SWQS). The following COPECs had an HQ that exceeded the threshold of 1: TCE; pesticides (4,4'-DDT, 4,4'-DDD); and metals (aluminum, barium, cadmium, cobalt, manganese, selenium, thallium, and vanadium).

Ecological Risk Assessment Summary

In summary, the SLERA identified several COPECs in surface soil and groundwater with concentrations exceeding NJDEP ecological screening criteria. Groundwater samples were conservatively screened against New Jersey's SWQS, although at the time of the SLERA, there were no identified complete exposure pathways identified from groundwater to surface water. COPECs in soil were primarily three metals (selenium, nickel, and zinc), which had concentrations that exceeded both NJDEP ecological screening criteria and background metal concentrations, two SVOCs, total PCBs, and DDx pesticides. COPECs in groundwater included TCE, several metals, and DDx pesticides.

The SLERA process proceeded to Step 3, which is Baseline Ecological Risk Assessment (BERA) Problem Formulation. Terrestrial food web exposure modeling was conducted to evaluate potential adverse effects to wildlife receptors (i.e., birds and mammals) that may forage at the Messer Property. 95% UCLs calculated in the SLERA were used as exposure point concentrations (EPCs) in soil, along with literature-based bioaccumulation factors (BAFs) to estimate food tissue concentrations and to calculate a dose of COPEC ingested. The dose was compared to literature-based toxicity reference values (TRVs) to calculate a HQ, and an HQ greater than the threshold of 1 indicates the potential for adverse effects. Based on the number of uncertainties identified in the SLERA and due to the conservative nature and uncertainty associated with the food web exposure models, HQs based on lowest observed adverse effect level (LOAEL) TRVs are generally given more weight. All the HQs were below the threshold value of 1 for all of the terrestrial receptors evaluated. Surface water samples were collected in December 2020 from SW-01 to SW-05 locations and were analyzed for VOCs and 1,4-dioxane. None of the concentrations in surface water exceeded NJDEP ecological screening criteria or EPA Region IV screening values for aquatic life. Therefore, there are no potential ecological risks to aquatic receptors posed by OU3.

Based on the results of the human health and ecological risk assessments, it is EPA's current judgment that the preferred alternatives identified in this Proposed Plan are necessary to protect human health or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are media-specific goals for protecting human health and the environment. They serve as the basis for developing remedial action alternatives and specify what the cleanup action will accomplish. The process of identifying the RAOs follows the identification of affected media and contaminant characteristics, evaluation of exposure pathways, contaminant migration pathways and exposure limits to receptors.

The following RAOs have been developed for OU3 groundwater:

- Restore groundwater in the underlying aquifer, and the underlying saprolite, to concentrations that meet federal or state standards;
- Prevent or minimize human ingestion/ inhalation/direct contact of contaminated groundwater on and downgradient (to the north) from OU3 until federal and state standards are met;
- Reduce potential migration of soil contamination to groundwater;
- Protect current and future occupants from adverse health effects that may result from

exposure to VOC-contaminated vapors within buildings located at OU3; and,

- Prevent and/or minimize contaminant migration from subsurface VI into indoor air within buildings located in OU3.
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Remediation Goals

The preliminary remediation goals (PRGs) for soil, groundwater and soil vapor are developed for the Contaminants of Concern (COCs), identified in this document to aid in defining the extent of the contaminated media requiring remedial action. The list of COCs is presented in the risk assessment and Appendix 1.

PRGs are generally chemical-specific remediation goals for each medium and/or exposure route that are established to protect human health and the environment. They can be derived from Applicable or Relevant and Appropriate Requirements (ARARs), risk-based levels (human health and ecological), and from comparison to background concentrations, where available.

See Appendix 1 – PRG Table– PRG Tables 1 through 3.

To achieve these RAOs, preliminary remediation goals for contaminated soil, groundwater, and soil vapor at OU3 were identified.

Soil - An OU3-specific PRG of 1 ppm has been established for TCE. At this level, soil is not expected to impact groundwater above PRGs. As it is lower than any potential direct contact values, it is also protective of all potential future land uses.

Groundwater - The lowest of the relevant federal maximum contaminant levels (MCLs), New Jersey MCLs, and New Jersey groundwater quality standards (GWQS) were used to develop the groundwater PRGs.

Vapor Intrusion – TCE: Residential - indoor air – 1.1 micrograms per cubic meter (ug/m^3). TCE: Commercial/ Industrial – indoor air – 3.0 ug/m^3.

The need for remedial activities to address vapor intrusion will be considered with other OU3-specific lines of evidence such as subsurface geology and hydrogeology, the structural characteristics of each building, and proximity to other impacted structures in determining the need for remedial action.

Principal Threat Waste

The National Contingency Plan (NCP) establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The "principal threat" concept is applied to the characterization of "source materials" at a Superfund site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water or air, or acts as a source for direct exposure. Contaminated soil can be a Principal Threat Waste; however, given that the concentration of VOCs in soil are relatively low, no principal threat wastes have been identified for OU3.

SUMMARY OF REMEDIAL ALTERNATIVES

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. Section

121(b)(1) of CERCLA also establishes a preference for remedial actions that employ, as a principal element, treatment to reduce permanently and significantly the volume, toxicity, or mobility of the hazardous substances, pollutants, and contaminants at a site. Section 121(d) of CERCLA, 42 U.S.C. § 9621(d), further specifies that a remedial action must attain a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains ARARs under federal and state laws, unless a waiver can be justified pursuant to Section 121(d)(4) of CERCLA, 42 U.S.C. § 9621(d)(4).

Detailed descriptions of the remedial alternatives summarized in this Proposed Plan for addressing soil, groundwater, and VI contamination are provided in the OU3 FS Report.

Three remedial alternatives have been developed for TCE-impacted soil. They include:

- Alternative S1—No Action
- Alternative S2—Excavation and Off-Site Disposal
- Alternative S3—In-situ Soil Mixing

Six remedial alternatives have been developed for groundwater. They include:

- Alternative G1—No Action
- Alternative G2—Monitored Natural Attenuation (MNA), VI Mitigation, and ICs
- Alternative G3—In-situ chemical reduction (ISCR), Groundwater Monitoring, VI Mitigation, and ICs
- Alternative G4—ISCR with a zero valent iron (ZVI) permeable reactive barrier (PRB), Groundwater Monitoring, VI Mitigation, and ICs
- Alternative G5—In-situ chemical oxidation (ISCO) in Groundwater, Groundwater Monitoring, VI Mitigation, and ICs
- Alternative G6—Ex-situ Groundwater Remediation and Discharge of Treated Water to Surface Water, Groundwater Monitoring, VI Mitigation, and ICs.

Soil Remedial Alternatives

Remedial Alternative S1 – No Action

The No Action alternative is required by the NCP to be carried through the screening process. Under this alternative, no action would be taken to remediate the TCE-impacted soil. This alternative would also not include ICs. Contaminants present in the soil would remain in place.

The No Action alternative provides a baseline for comparison with other active remedial alternatives. Because no remedial activities would be implemented under the No Action alternative, long term human health and environmental risks would remain the same as those identified in the HHRA. There are no capital, operations /maintenance, or monitoring costs and no permitting or institutional legal restrictions needed.

Estimated Capital Cost:	$0
Estimated Construction Timeframe:	0 weeks
Estimated Time to Achieve RAOs:	0 months

Remedial Alternative S2 – Excavation and Off-Site Disposal

This alternative includes: (1) excavation of TCE-impacted soils above the soil PRG, (2) off-Site disposal of TCE-impacted soils, (3) confirmation soil sampling, (4) backfill with approved clean fill, and (5) property restoration. A pre-design investigation (PDI) would be completed to further define the TCE-impacted soils above the PRGs in the vadose, smear zone and saprolite at each source area and determine whether engineering controls or active remediation (e.g. excavation or treatment as part of the groundwater remedy) would be needed to remediate the smear zone. This remedial alternative would include:

- Sampling to ensure reduction of TCE to achievement of PRGs; and
- Restoration of the area to grade and pre-existing conditions.

Estimated Capital Cost: $410,000
Estimated Construction Timeframe: 4 weeks
Estimated Time to Achieve RAOs: < 6 months

Remedial Alternative S3 – *In-situ* Chemical Treatment/Soil Mixing

This alternative includes: (1) introduction of ISCR via mechanical mixing to subsurface soil, (2) confirmatory soil sampling and (3) property restoration. A PDI would be completed to further define the TCE-impacted soils above the PRGs in the vadose, smear zone, and saprolite. This remedial alternative would include:

- Application and mixing of chemical reductant in TCE-impacted soil from the ground surface to the water table (maximum of 10 feet bgs)
- Sampling to ensure reduction of TCE to achievement of PRGs; and
- Restoration of the area to grade and pre-existing conditions.

Estimated Capital Cost: $640,000
Estimated Construction Timeframe: 4 weeks
Estimated Time to Achieve RAOs: < 6 months

Groundwater Remedial Alternatives

Remedial Alternative G1 – No Action

The No Action alternative is required by the NCP to be carried through the screening process. Under this alternative, no action would be taken to remediate the contaminated groundwater. This alternative would also not include ICs. Contaminants present in the groundwater would remain in place and continue to migrate.

The No Action alternative provides a baseline for comparison with other active remedial alternatives. Because no remedial activities would be implemented under the No Action alternative, long term human health and environmental risks would remain the same as those identified in the HHRA. There are no capital, operations /maintenance, or monitoring costs and no permitting or institutional legal restrictions are needed, but this alternative will not meet the RAOs established for groundwater.

Estimated Capital Cost: $0
Estimated Construction Timeframe: 0 weeks
Estimated Time to Achieve RAOs: 0 months

Common Elements

Alternatives G2 through G6 described below would require ICs, such as a Classification Exception Area/Well Restriction Area (CEAs/WRA), which is a restriction established under New Jersey regulations that would provide notice that the groundwater does not meet designated use requirements and would restrict groundwater uses or activities which could result in direct contact with contaminated groundwater. A NJDEP CEA/WRA would be established to restrict future groundwater use activities that would expose users to contaminants at levels that may pose human health risk, until RAOs are met.

Alternatives G2-G6 also include VI sampling, design, installation, and operation and maintenance of VI mitigation system(s) where EPA determines it is required, and performance monitoring. The evaluation will include lines of evidence such as subsurface geology and hydrogeology, the structural characteristics of each building, and proximity to other impacted structures in determining the need for VI remedial action.

Remedial Alternative G2 – MNA, VI Mitigation, and ICs

This alternative includes: (1) MNA to address potential impacts from the COCs, (2) VI investigation and, if required, mitigation, and (3) ICs to prevent groundwater use or other activities incompatible with remedy effectiveness. The five-year reviews would be conducted until groundwater restoration is achieved.

A MNA program would be implemented to monitor COC concentrations, assess the effectiveness of natural attenuation processes, and confirm long-term achievement of RAOs. The MNA program would be used to verify that the concentrations of COCs are decreasing over time and are not increasing in areas downgradient (to the north) of OU3.

MNA would include annual monitoring for TCE and its degradation compounds, as well as natural attenuation parameters, such as dissolved oxygen, nitrate, iron (II), sulfate, methane, oxidation-reduction potential (ORP), chloride, alkalinity, and hydrogen.

Alternative G2 would include the following remedial components:

- Utilization of existing wells and installation of additional groundwater monitoring wells to monitor COC concentrations, assess the effectiveness of natural attenuation processes, and confirm long-term achievement of RAOs;
- Implementation of ICs to prohibit groundwater use or access; and
- 5-year reviews.

Estimated Capital Cost:	$176,020
Estimated O&M Cost:	$463,514
Estimated Monitoring Cost:	$976,347
Estimated 30-Year Present Worth Cost:	$1,620,000
Estimated Construction Timeframe:	<6 months
Estimated Time to Achieve RAOs:	>100 years

<u>Remedial Alternative G3 – ISCR in Groundwater, Groundwater Monitoring, VI Mitigation, and ICs</u>

This alternative includes: introduction of ISCR through injections to address areas with the highest groundwater contamination, groundwater performance monitoring to ensure that COC concentrations are decreasing over time, VI investigation and, if required, mitigation, and ICs.

A PDI would be completed that includes groundwater VOC sampling. Data collected during the PDI would be used to better define the geochemistry and volumes of groundwater needing treatment and help in the development of a remedial design for the remedy. This will include the assessment of areas for the injection location(s) (and depths).

Under this alternative, ISCR would focus on injecting an active carbon sequestration agent into the contaminant plume to facilitate destruction of the contamination with reductive dechlorination of chlorinated volatile organic compounds (CVOC) at OU3. The alternative would consist of several lines of injections perpendicular to the groundwater flow using a Geoprobe® or similar technology.

Alternative G3 would include the following remedial components:

- Investigation of current OU3 conditions and plume delineation;
- Completion of a treatability study to determine the appropriate chemical reductant for COCs;
- Injection of chemicals for ISCR of COC-contaminated groundwater;
- Monitoring of concentrations of COCs to assess the effectiveness of treatment and to confirm long-term achievement of RAOs;
- Implementation of ICs; and
- 5-year reviews.

Estimated Capital Cost:	$3,040,000
Estimated O&M Cost:	$640,641
Estimated Monitoring Cost:	$676,410
Estimated 30-Year Present Worth Cost:	$4,360,000
Estimated Construction Timeframe:	24-36 months
Estimated Time to Achieve RAOs:	~20 years

<u>Remedial Alternative G4 –ISCR with a ZVI PRB, Groundwater Monitoring, VI Mitigation, and ICs</u>

This alternative includes: introduction of ISCR through grid injection and barrier systems to address areas with the highest groundwater impacts, groundwater performance monitoring to ensure that COC concentrations are decreasing over time, VI investigation and, if required, mitigation, and ICs. The remedy components to Alternative G4 are identical to Alternative G3 with the exception that G4 includes a trenched ZVI PRB for the area adjacent to River Road and G3 has individual injection points. Only the trenched ZVI PRB remedy element is described below.

A PDI would be completed that includes groundwater VOC sampling. Data collected during the PDI would be used to better define the geochemistry and volumes of groundwater needing treatment for the development of a remedial design for the remedy. This will include the assessment of final areas for direct injections and the final PRB location(s) (and depths).

In addition to ISCR, a PRB would be trenched in, rather than direct injection, in the area south of River Road to provide greater contact of groundwater with reactive materials (i.e. ZVI). The PRB would be installed parallel to River Road on the Messer Property. The PRB (nominally 3 feet wide) would extend below the water table and would be expected to key into the underlying low permeability saprolitic material. It would be backfilled with reactive media (e.g. iron filing or ZVI and sand) to treat dissolved CVOCs in the groundwater passing through the PRB. Before installation, a pre-design study (including bench scale testing) would be completed to determine the final dimensions and composition of the PRB to optimize treatment and long-term effectiveness. Based on preliminary analysis, it is expected that the PRB would extend to a depth of approximately 25 feet bgs with reactive media placed between the interval of 10 and 25 feet bgs to intercept impacted groundwater.

Alternative G4 would include the following remedial components:

- Investigation of current OU3 conditions and plume delineation;
- Completion of a treatability study to determine the appropriate chemical reductant for COCs and ZVI trench specifications;
- Injection of chemicals for ISCR;
- Trenched PRB;
- Monitoring to assess the effectiveness of treatment and to confirm long-term achievement of RAOs;
- Implementation of ICs; and
- 5-year reviews (same as G3).

Estimated Capital Cost:	$3,520,000
Estimated O&M Cost:	$640,641
Estimated Monitoring Cost:	$676,410
Estimated 30-Year Present Worth Cost:	$4,840,000
Estimated Construction Timeframe:	24-36 months
Estimated Time to Achieve RAOs:	~20 years

<u>Remedial Alternative G5 – ISCO in Groundwater, Groundwater Monitoring, VI Mitigation, and ICs</u>

This alternative includes: introduction of chemical oxidant directly into the groundwater through a grid injection system to address areas of the highest groundwater contamination, groundwater performance monitoring to ensure that COC concentrations are decreasing over time, VI investigation and, if required, mitigation, and ICs.

A PDI would be completed that includes groundwater VOC sampling. Data collected during the PDI would be used to better define the geochemistry and volumes of groundwater needing treatment for the development of a remedial design for the remedy. This will include the assessment of final areas for direct injections.

Alternative G5 involves the direct injection of a persistent oxidant with iron chelate and sodium hydroxide (alkaline persulfate activator) across multiple injection lines using direct-push methods. The proposed oxidant, sodium persulfate, is a persistent, liquid oxidant whose primary application is the in-situ chemical destruction of chlorinated hydrocarbons like TCE and PCE. Multiple injection events, spaced 12 months apart, would be needed to achieve PRGs.

Alternative G5 would include the following remedial components:

- Investigation of current OU3 conditions and plume delineation;
- Completion of a treatability study to determine the appropriate chemical oxidant for COCs;
- Injection of a chemical oxidant into the contaminated groundwater;
- Monitoring of concentrations of COCs to assess the effectiveness of treatment and to confirm long-term achievement of RAOs;
- Implementation of ICs;
- 5-year reviews.

Estimated Capital Cost:	$2,040,000
Estimated O&M Cost:	$5,549,002
Estimated Monitoring:	$676,410
Estimated Total Present Worth Cost:	$8,180,000
Estimated Construction Timeframe:	24-36 months
Estimated Time to Achieve RAOs:	~20 years

<u>Remedial Alternative G6 – Ex-situ Groundwater Remediation and Discharge of Treated Water to Surface Water, Groundwater Monitoring, VI Mitigation, and ICs</u>

This alternative includes: groundwater extraction, construction of a groundwater treatment system and discharge to surface water, groundwater monitoring to ensure that COC concentrations are decreasing over time, VI investigation and, if required, mitigation and ICs.

A PDI would be completed that includes groundwater VOC sampling. Data collected during the PDI would be used to better define the geochemistry and volumes of groundwater needing treatment for the development of a remedial design for the remedy. This will include the assessment of final areas for extraction wells. Pilot testing, bench testing, and/or field measurements would be required as part of the PDI to determine if any type of pre-treatment of the groundwater is required prior to passing through the treatment system.

Alternative G6 includes the installation of approximately four extraction wells. The extraction wells would be installed to a depth determined during the remedial design. The pumping rate would be determined during the PDI/remedial design.

Contaminated groundwater from the extraction well(s) in the area north of River Road would be conveyed to a treatment plant using double-walled high-density polyethylene (HDPE) piping. The treatment system would include a metals removal system, air stripping, and vapor and liquid granular activated carbon ("GAC") adsorption. The treated water from the area north of River Road would be discharged to the unnamed tributary of the Delaware River. For cost estimating purposes, it is assumed that the pump and treat system would be operated for a period of 30 years.

Contaminated groundwater from the extraction well(s) at OU3 would be conveyed to a treatment plant using double-walled HDPE piping. The treatment system would include a metals removal system, air stripping, and vapor and liquid GAC adsorption. The treated water would be discharged to the onsite storm sewer, which outfalls into the unnamed tributary to the northwest. For cost estimating purposes, it is assumed that the pump and treat system would be operated for a period of 30 years for OU3.

Alternative G6 would include the following remedial components:

- Investigation of current OU3 conditions and plume delineation;
- Construction of a treatment system building, which would include a vapor collection and treatment system;
- Ex-situ treatment of the groundwater, including two treatment plants with metals removal system, air stripping, vapor phase GAC adsorption, and liquid phase GAC adsorption; the treatment plants would be constructed near the extraction wells;
- Groundwater monitoring to confirm a reduction of COC concentrations; air emission sampling and reporting to ensure air permitting compliance;
- 5-year reviews; and
- Operation, maintenance, and monitoring (O&M).

Estimated Capital Cost:	$3,349,055
Estimated O&M Cost:	$8,244,267
Estimated Monitoring:	$894,349
Estimated Total Present Worth Cost:	$11,590,000
Estimated Construction Timeframe:	4-8 months

Estimated Time to Achieve RAOs: Approximately >30 years.

EVALUATION OF ALTERNATIVES

In evaluating the remedial alternatives, each alternative is assessed against nine evaluation criteria set forth in the NCP, namely overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity; mobility, or volume through treatment; short-term effectiveness; implementability; cost; and state and community acceptance. See box entitled "The Nine Superfund Evaluation Criteria" for a more detailed description of these evaluation criteria.

This section of the Proposed Plan evaluates the relative performance of each alternative against the nine criteria, noting how each alternative compares to the other options under consideration. A more detailed analysis of alternatives can be found in the OU3 FS report.

THE NINE SUPERFUND EVALUATION CRITERIA

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

2. **Compliance with Applicable or Relevant and Appropriate Requirements (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.

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

4. **Reduction of Toxicity, Mobility, or Volume (TMV) 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.

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

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

7. **Cost** includes estimated capital and annual operations 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.

8. **State/Support Agency Acceptance** considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

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

Threshold Criteria

Overall Protection of Human Health and the Environment

Soil

Alternative S1 (No Action) would not meet the RAOs and would not be protective of human health and the environment since no action would be taken. Alternatives S2 and S3 would provide protection of human health because the exposure pathways to human receptors would be eliminated by excavation and off-site disposal or in-situ chemical treatment/soil mixing.

Groundwater

Alternative G1 (No Action) would not meet the RAOs and would not be protective of human health and the environment since no action would be taken. Alternatives G2, G3, G4, G5, and G6 would provide protection of human health because the exposure pathways to human receptors would be eliminated by institutional controls, which would place restrictions on the use of groundwater within the area of groundwater contamination, and through MNA (Alternative G2) or various treatment technologies (Alternatives G3, G4, G5 and G6) However, the different alternatives (Alternatives G2 through G6) would restore the aquifer in different timeframes.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Actions taken at any Superfund site must meet all ARARs under federal and state laws or provide grounds for invoking a waiver of those requirements.

Soil

Alternative S1 would not comply with ARARs. An OU3-specific PRG of 1 ppm has been established for TCE. Alternative S2 and S3 would comply with action- and location-specific ARARs such as hazardous waste storage during remediation (40 CFR 265.171).

Groundwater

Alternative G1 would not comply with ARARs. Alternatives G3, G4, G5 and G6 are expected to be able to meet action- and location-specific ARARs. Alternatives G3, G4, G5 and G6 would use treatment to achieve chemical-specific ARARs such as NJDEP Ground Water Quality Standards (GWQS) and federal and state drinking water standards. In the interim, the exposure pathways to human receptors would be eliminated by restrictions placed on the use of groundwater within the area of groundwater contamination through the establishment of a

CEA. Chemical-specific ARARs for the COCs would be met under varying timeframes under each alternative.

Balancing Criteria

Long-Term Effectiveness and Permanence

Soil

Alternative S1 would not provide long-term effectiveness and permanence. Alternative S2 would provide the most long-term effectiveness and permanence as excavation and off-site disposal would remove the source(s) of contamination. Alternative S3 would provide the second most long-term effectiveness and permanence as in-situ chemical treatment/soil mixing would remediate source(s) but not as quickly or effectively as Alternative S2.

Groundwater

Alternative G1 (No Action) would not provide long-term effectiveness and permanence since groundwater contamination would not be addressed. Alternative G2 would provide the second least long-term effectiveness and permanence since MNA would result in the longest time frames to restore the aquifer (>100 years). Alternatives G3, G4, and G5 would provide the most long-term effectiveness and permanence as they use effective technologies for addressing groundwater contaminated with COCs and they would result in the shortest timeframes for groundwater remediation (approximately 20 years). Alternative G6 would provide the second most long-term effectiveness and permanence since it uses an effective technology for addressing groundwater contaminated with COCs; however, groundwater remediation would take longer than Alternatives G3, G4, and G5 (>30 years).

Climate Change

Potential site impacts from climate change have been assessed, and the performance of the remedial alternatives is currently not at risk due to the expected effects of climate change in the region and near the Site.

Reduction of Toxicity, Mobility, or Volume (TMV) through Treatment

Soil

Alternative S1 (No Action) does not address the contamination through treatment, so there would be no reduction in TMV. Potentially Alternative S2 would reduce the TMV of contaminants through treatment of the contaminated soil in the smear zone, and Alternative S3 would reduce the TMV of contaminants through in-situ chemical treatment/soil mixing.

Groundwater

Alternatives G3, G4, and G5 would satisfy the criterion of reducing toxicity, mobility, or volume of contaminants through treatment to a high degree because these technologies would, through chemical reduction or chemical oxidation, achieve PRGs within 20 years, respectively, and prevent further migration through treatment. Alternative G2 would not satisfy this criterion because it does not include active treatment. Natural attenuation processes at OU3 do not appear to be robust, since there are less than optimal geochemical conditions (i.e., high ORP, low DO, low pH) in most areas of OU3, and there is a potential for further migration of the contaminant plume to the northwest.

Short-Term Effectiveness

Soil

Alternative S1 would have no short-term effectiveness or impacts since no action would be implemented. Alternative S2 would have the most short-term effectiveness and impacts as excavation and off-site disposal would be completed in the least amount of time. Alternative S3 would have the next most short-term effectiveness and impacts as S3 would take longer to implement.

Groundwater

Alternative G1 and G2 would have no or limited short-term impacts since no action would be implemented (G1) and long-term monitoring for MNA (G2) has minimal short-term impacts.

Alternatives G3 and G4 could pose minimal short-term risks to workers during the injection phases when chemicals are mixed and injected underground onsite. Trenching for Alternative G5 increases short-term risk associated with additional construction equipment like soil trenchers along a railroad right-of-way.

In addition, the ISCR amendments would pose little if any exposure or handling risk to onsite workers. Sodium persulfate, used in Alternative G5, is a strong oxidizer, and workers in the transportation and use of persulfate would need to follow proper industry practices to ensure its safe use. The sodium hydroxide, a strong alkali used to activate the persulfate, would also need to be handled carefully by trained injection workers. Normal industrial hygiene practices, which include the use of such protective equipment such as chemical goggles, gloves, and work clothing that covers arms and legs, would be established to minimize the risk of any such exposure.

As an oxidant, sodium persulfate itself is noncombustible but will accelerate the burning of combustible materials. Therefore, contact with all combustible materials (e.g., wood and paper) and/or organic chemicals (e.g., jet fuel) would be avoided. There is some risk that G5 would create off-gassing issues in the area northwest of River Road into buildings from the oxidation of organics reaction process.

While each of the active groundwater alternatives (G3, G4, G5, and G6) would have short-term impacts such as the need for traffic control of the property workers and the local communities, these disruptions would be minimized through noise and traffic control plans, as well as community air monitoring programs during construction to minimize and address any potential impacts to the community, remediation workers, and the environment.

Implementability

Soil

While each of the remedial alternatives are technically feasible and implementable, the degree of difficulty is determined by specific construction activities that will need to occur. Alternative S2 involves the excavation of TCE-impacted soils and would present limited challenges in implementation in the heavily developed areas near the Messer Property. Alternative S3 would be slightly more difficult to implement as it includes the mixing of chemicals with the TCE-impacted soil in-situ.

Groundwater

While each of the remedial alternatives are technically feasible and implementable, the degree of difficulty in implementing each alternative varies.

Alternative G1 involves no action and, thus, no implementation. Alternative G2 would be the easiest alternative to implement as no physical construction of a remedial system is associated with this alternative. Alternatives G3 and G5 would be the next easiest to implement as these alternatives only include the drilling and injection of substrates into the aquifer and there is no above-ground excavation or construction. Alternative G4 would be the next easiest to implement as this alternative comprises all of the components of G3 and G4, with the addition of the excavation and installation of a PRB. Lastly, Alternative G6 would include the most challenges to implementability as it includes the most construction activities including the drilling and installation of extraction wells, the excavation and installation of conveyance piping and the construction of a treatment plant. This construction would present varying challenges in the heavily developed areas near the Messer Property.

Alternative G6 might also include potential acquisition of land north of River Road for the construction of a treatment plant and coordination with local authorities for street opening for the installation of extraction wells. Alternatives G3, G4, and G5 would also require coordination with local authorities for street opening for the drilling and injection of substrates into the aquifer.

Alternatives G3, G4, G5, and G6 would also cause disruptions to traffic to inject substrate and to install underground conveyance piping between the extraction wells and the centralized treatment plant, and from the treatment plant to the surface water discharge location. The most disruptive of these alternatives would be Alternative G6 due to the higher number of wells, the need for two separate treatment plants to provide appropriate treatment associated with the large number of wells, and longer length of pipe required to be installed.

Further, Alternative G6 would have significantly more negative impact on this protected aquifer compared to Alternatives G3, G4, and G5 as it includes extraction of contaminated groundwater. This is an important consideration for this aquifer, which is designated as NJDEP Water Supply Critical Area II.

Cost

A comparative summary of the cost estimates for each alternative is presented below. Present worth is calculated using a 7% discount rate.

Alternative	Capital Cost	Total O&M Cost	Total Present-Worth Cost
Soil			
S1	$0	$0	$0
S2	$410,000	$0	$0
S3	$640,000	$0	$0
Groundwater			
G1	$0	$0	$0
G2	$176,020	$1,439,861	$1,620,000
G3	$3,040,000	$1,317,051	$4,360,000
G4	$3,520,000	$1,317,051	$4,840,000
G5	$2,040,000	$6,225,412	$8,180,000
G6	$3,349,055	$9,138,616	$11,590,000

<u>Modifying Criteria</u>

State / Support Agency Acceptance

EPA's Preferred Alternatives as presented in this Proposed Plan are under review by the State of New Jersey.

Community Acceptance

Community acceptance of the Preferred Alternatives will be evaluated after the public comment period ends and all comments are reviewed. Comments received during the public comment period will be addressed in the Responsiveness Summary section of the ROD. The ROD is the document in which EPA will select the remedy for OU3 of the Site.

PREFERRED ALTERNATIVES

Based upon an evaluation of the remedial alternatives, EPA proposes Soil Alternative S2 – Excavation and Off-Site Disposal and Groundwater Alternative G3 - ISCR in Groundwater, Groundwater Monitoring, VI Mitigation, and ICs as the preferred Remedial Alternatives for OU3 of the Site.

Soil Remedial Alternative S2 has the following components:

- excavation of TCE-impacted soils above the soil PRG;
- off-site disposal of TCE-impacted soils;
- confirmation soil sampling;
- backfill with approved clean fill; and
- property restoration.

A PDI would be completed to further define the TCE-impacted soils above the PRG in the vadose, smear zone and saprolite at each source area and whether engineering controls or active remediation (e.g. excavation or treatment as part of the groundwater remedy) would be needed to remediate the smear zone.

Groundwater Remedial Alternative G3 includes the following remedial components:

- Completion of a treatability study to determine the appropriate chemical reductant for COCs;
- Injection of chemicals for in-situ ISCR of COC-contaminated groundwater;
- Monitoring of concentrations of COCs to assess the effectiveness of treatment and to confirm long-term achievement of RAOs;
- VI Mitigation, which includes sampling, design installation and operation and maintenance of required system(s) and performance monitoring.
- Implementation of ICs, consisting of CEA/WRA to restrict groundwater use or access; and
- Five-Year Reviews.

A PDI would be completed that includes groundwater sampling. Data collected during the PDI would be used to better define the geochemistry and volumes of groundwater needing treatment and help in the development of a remedial design for the remedy. This will include the assessment of final areas for the final injection location(s) and depths.

Under this alternative, ISCR will focus on injecting an active carbon sequestration in the plume to facilitate reductive dechlorination of CVOC contamination at OU3. The alternative would consist of several lines of injections perpendicular to the groundwater flow using a Geoprobe® or similar technology.

A long-term groundwater monitoring program would be implemented to track and monitor changes in the groundwater contamination to ensure the RAOs/PRGs are attained throughout the plume. The results from the long-term monitoring program would be used to evaluate the migration of contaminants and changes in OU3-related COCs over time.

A vapor intrusion evaluation and mitigation program, which includes evaluation of geology, hydrogeology, and characteristics of each potentially-impacted building, and where determined to be necessary, sampling, design, installation and operation and maintenance of required system(s) and performance monitoring would be implemented to protect current and future occupants from adverse health effects that may result from exposure to VOC-contaminated vapors within buildings located in OU3.

ICs in the form of a CEA/WRA would be established to ensure that the remedy remains protective until RAOs are achieved for protection of human health over the long term.

The environmental benefits of the preferred alternatives could be enhanced by giving consideration, during the remedial design, to technologies and practices that are sustainable in accordance with EPA Region 2's Clean and Green Guidance.

The total estimated present-worth cost for the preferred groundwater alternative is $4,360,000. The total estimated cost of the preferred soil alternative is $410,000. These are engineering cost estimates that are expected to be within the range of plus 50 percent to minus 30 percent of the actual project cost. Further details on the costs are presented in Sections 10.1.7 (soil) and 10.2.7 (groundwater) of the OU3 FS Report.

While the preferred remedy would ultimately result in reduction of contaminant levels in groundwater such that levels would allow for unlimited use and unrestricted exposure, it is anticipated that it would take longer than five years to achieve these levels. As a result, in accordance with CERCLA, the Site is to be reviewed at least once every five years until cleanup levels are achieved and unrestricted use is achieved.

Basis for the Remedy Preference

Soil Alternative S2 is the preferred soil alternative because it meets the threshold criteria to protect human health and the environment by remediating the soil to protective levels and would provide the most long-term effectiveness and permanence as excavation and off-site disposal would remove the source(s) of contamination. Soil excavation and off-site disposal uses proven methods which have been demonstrated to be effective at reducing contaminant mass to achieve cleanup standards for VOC-contaminated soil. EPA believes that Alternative S2 would be a relatively short-term action of approximately four weeks. Although some disruption is associated with excavation, the impacts are easily mitigated with proper traffic control, order management, and signage.

Groundwater Alternative G3 is the preferred groundwater alternative because it meets the threshold criteria to protect human health and the environment by in-situ treatment of groundwater to achieve NJGWQS. Alternative G3 provides the long-term effectiveness and permanence as in-situ treatment would eliminate the source(s) of groundwater contamination in a reasonable timeframe.

Although Alternatives G3, G4, G5, and G6 meet the threshold evaluation criteria based on the balancing criteria evaluation, Alternative G3 eliminates the impacts in groundwater within a reasonable timeframe (less than 30 years) through direct treatment, as opposed to Alternative G6 which is expected to take more than 30 years due to potential matrix back diffusion concerns. Alternative G3 would not create potential land subsidence or cause traffic/logistical issues to property owners from aquifer soil mixing (Alternative G4) or from construction and O&M of a groundwater pump and treat system (Alternative G6). Alternative G3 remediation also will not create potential off-gassing effects as associated with Alternative G5.

In-Situ chemical treatment uses proven methods which have been demonstrated to be effective at reducing contaminant mass to achieve cleanup standards for VOC-contaminated groundwater. G3 requires a lower number of injections due to the effectiveness of ISCR compared with ISCO and utilizes agents that are generally less corrosive and volatile.

Based upon the information currently available, EPA believes the preferred alternatives for soil, S2, and groundwater, G3, meet the threshold criteria and provide the best balance of tradeoffs compared to the other alternatives with respect to the balancing criteria. EPA expects the preferred alternatives to satisfy the following statutory requirements of Section 121(b) of CERCLA: 1) they are protective of human health and the environment; 2) they comply with ARARs; 3) they are cost effective; 4) they utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) they satisfy the preference for treatment as a principal element. The preferred alternatives will be readily implementable using technologies proven to be effective at this Site. The short-term effects of the preferred alternatives include potential impacts to workers and the nearby community, but these would be mitigated using the appropriate health and safety measures.

For further information on the Cinnaminson Groundwater Contamination Superfund Site, please contact:

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Written comments on this Proposed Plan should be submitted on or before August 31, 2022, to Alida Karas at the address or email below

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Appendix 1
Table 1
Preliminary Remediation Goals for Groundwater
Cinnaminson Groundwater Contamination Site OU3
Burlington County, New Jersey

Contaminant of Concern	CAS Number	NJDEP GWQS (µg/L)	Federal MCL (µg/L)	NJDEP Drinking Water MCLs (µg/L)	Preliminary Remediation Goals (µg/L)
VOLATILE ORGANIC COMPOUNDS (VOCs)					
Trichloroethene (TCE)	79-01-6	1	5	1	1
Vinyl Chloride (VC)	75-01-4	1	2	2	1

Notes:

The Preliminary Remediation Goal is the minimum of the individual listed criteria.

Abbreviations:

CAS = Chemical Abstracts Service

MCL = Maximum Contaminant Level (NJDEP 2009a, EPA 2009)

NJDEP GWQS = New Jersey Department of Environmental Protection (NJDEP) Groundwater Quality Standard (GWQS, 2021)

µg/L = micrograms per liter

Table 2
Preliminary Remediation Goals for Soil
Cinnaminson Groundwater Contamination Site OU3
Burlington County, New Jersey

Contaminant of Concern	CAS Number	NJDEP SRS, Ingestion-Dermal, Residential (mg/Kg)	NJDEP SRS, Ingestion-Dermal, Non-Residential (mg/Kg)	NJDEP SRS, Inhalation, Residential (mg/Kg)	NJDEP SRS, Inhalation, Non-Residential (mg/Kg)	NJDEP SRS, Migration to Groundwater (mg/Kg)	Preliminary Remediation Goals (mg/Kg)
VOLATILE ORGANIC COMPOUNDS (VOCs)							
Trichloroethene (TCE)	79-01-6	15	79	3	14	0.0065	1*

Notes:

Preliminary remediation goals are the lowest of the listed values for a given analyte.

Values are for total polychlorinated biphenyls.

* = A site-specific preliminary delineation criteria for TCE in soil of 1 mg/kg was approved for the RI by EPA and NJDEP

Abbreviations:

CAS = Chemical Abstracts Service

mg/kg = Milligrams per kilogram

NC = No criteria available

NJDEP = New Jersey Department of Environmental Protection

per N.J.A.C. 7:26D, last amended May

Appendix 1

Table 3
Preliminary Remediation Goals
for Vapor Intrusion Indoor Air
Cinnaminson Groundwater
Contamination Site OU3
Burlington County, New Jersey

Contaminant of Concern	CAS Number	Vapor Intrusion Residential Indoor Air Remediation Standard (µg/m³)*	Vapor Intrusion Nonresidential Indoor Air Remediation Standard (µg/m³)*
		Indoor Air	Indoor Air
TCE	79-01-6	1.1	3

*NJDEP Master Table Indoor Air Remediation Standards 2021

CAS = Chemical Abstracts Service

µg/m3 = Micrograms per cubic meter