INTERIM EARLY ACTION
PROPOSED PLAN FOR
LCP CHEMICALS GEORGIA SUPERFUND SITE
BRUNSWICK, GLYNN COUNTY, GEORGIA
OPERABLE UNIT 2 – GROUNDWATER AND CELL BUILDING AREA
JULY 1, 2024

Introduction

The U.S. Environmental Protection Agency (EPA) is issuing this **Proposed Plan**[1] for **Operable Unit** 2 (OU2) at the LCP Chemicals Georgia **Superfund** Site (Site) in Brunswick, Glynn County, Georgia. The EPA is the lead agency for the Site, and the Georgia Environmental Protection Division (GAEPD) is the support agency. OU2 consists of contaminated **groundwater** beneath the Site and soil beneath the former **chlor-alkali** cell building area (CBA). This Proposed Plan summarizes the history and extent of contamination at OU2, the cleanup process, and cleanup options under consideration to reduce risks to the community and the environment associated with mercury contaminated groundwater and subsurface soil at the CBA. This source control action will address all environmental media (subsurface soil and groundwater) within the CBA. The EPA is requesting public comment on its **preferred remedial alternative** (i.e., the Preferred Alternative) for the CBA portion of OU2. The remainder of OU2 (i.e., the groundwater outside of the CBA) will be addressed by a subsequent remedy. Additional details regarding the Site can be found in the **Remedial Investigation** Report **(RI) and** Focused **Feasibility Study** Report (FFS) and other documents contained in the **Administrative Record** (AR) for the Site. The link to the AR will be available on the EPA Site Profile Page link listed below. This Interim Early Action Proposed Plan highlights key information from the RI Report and the FFS Report. The EPA encourages the public to review the documents in the AR to gain an understanding of the environmental investigation activities and risk assessments that have been conducted at the Site. In addition, the major supporting documents are available on the EPA Site Profile Page at: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0401634.

Please refer to Figure 1 for a map showing the location of the Site, which is just outside the limits of the City of Brunswick, in Glynn County, Georgia. Locations of historical operations are shown on Figure 2.

The EPA is issuing this Interim Early Action Proposed Plan as part of its public participation responsibilities under Section 117(a) of the **Comprehensive Environmental Response, Compensation and Liability Act** (CERCLA or Superfund) and the Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan** (NCP). The community is invited to ask questions about the Proposed Plan and to learn more at a public meeting on July 18, 2024, at 5:30 PM at Zion Rock Missionary Baptist Church, 3200 Gordon St, Brunswick, GA 31520. Additional information about the public comment period and a public meeting are presented below. The EPA invites you to review and comment on the Proposed Plan during this period, and also invites you to review material, ask questions, and participate in making a final decision about the Preferred Alternative during the public meeting. The EPA, in consultation

[1] Terms appearing in bold print are defined in the glossary at the end of this Proposed Plan.

with the GAEPD, may modify the Preferred Alternative in response to public comments or new information. Therefore, you are encouraged to review and comment on this Interim Early Action Proposed Plan. A final remedy will be proposed for OU2 in a later Proposed Plan.

The EPA, in consultation with GAEPD, will select the interim early action **remedy** for OU2 after the public comment period has ended and the information submitted during the comment period has been reviewed and considered. The final decision will be documented in an Interim Early Action **Record of Decision** (IROD). The IROD will include a **Responsiveness Summary** to explain EPA's response to each comment received during the public comment period.

How You Can Be Involved

Public Comment Period (30 days)
July 5, 2024
Additional time may be requested in writing.

Mail your written comments to:

Robert Pope
Remedial Project Manager
U.S. Environmental Protection Agency
61 Forsyth Street SW
Atlanta, GA 30303

Or e-mail your comments to:
Pope.robert@epa.gov

Comments must be received by August 5, 2024
The EPA will accept written and oral comments and respond to them in the final decision document. A final cleanup decision will not be made until all comments are considered.

Public Meeting
July 18, 2024, 5:30 PM at Zion Rock Missionary Baptist Church, 3200 Gordon St, Brunswick, GA 31520

During the public meeting, the EPA will present and explain the information contained in this Proposed Plan. You will be able to ask questions and tell EPA representatives what you think about the cleanup alternatives. The EPA will accept written and oral comments and respond to them in the final decision document. A final cleanup decision will not be made until all comments are considered.

For additional information, or to obtain another copy of this Proposed Plan, contact Angela Miller, EPA Community Involvement Coordinator, at 404-562-8561 or miller.angela@epa.gov.

EPA's Preferred Alternative is *Alternative 3 –In-situ Chemical Sequestration (a form of chemical treatment), Improvement and Maintenance of the Existing Soil Dermal Cover, and Institutional Controls (in the form of the existing Environmental Covenant and Zoning restrictions).* Note: This alternative has been modified from the FFS as Sitewide groundwater monitoring including sampling for **Monitored Natural Attenuation (MNA)** parameters is now planned to be conducted pursuant to the 1995 Administrative Order by Consent for Remedial Investigation/Feasibility Study. This alternative consists of the improvement and maintenance of the existing soil dermal cover over all portions of contaminated soil in the CBA to minimize water infiltration (by being graded to promote runoff) and limiting inadvertent human intrusion activities. The cover would be sloped, where possible, to facilitate drainage and would be constructed to a uniform thickness of at least 24 inches (2 feet). Mercury (Hg) is present at the LCP Site in multiple forms: an elemental state (Hg^0) of metallic mercury observed as discrete "beads" in the subsurface, in a state where it has formed compounds (usually salts) in the soil and aquifer matrix, and in a dissolved state in groundwater. In-situ chemical sequestration (ICS) (a form of chemical treatment) using polysulfide and/or other amendments as appropriate, would be applied to the subsurface prior to finalizing the soil cover to convert elemental mercury (Hg^0) to a form of mercuric sulfide and to minimize the dissolution of mercury. Other existing forms of mercury in the subsurface treatment area would also be addressed and converted to insoluble and less mobile forms of mercuric sulfide. This alternative is recommended because it will achieve substantial risk reduction by both treating the source materials constituting principal threats at the Site and providing safe management of remaining material. This combination reduces risk sooner and takes less time than the other alternatives. Although it was stated in EPA's approval of the FFS that evaluation of MNA through periodic groundwater monitoring (including MNA parameters) would be a component of the alternatives evaluated for this Proposed Plan, EPA has since requested that the Potentially Responsible Parties (PRPs) implement periodic groundwater monitoring as soon as possible to provide information for the evaluation of a final remedy that addresses all **chemicals of concern** (COCs) in groundwater. EPA has requested the monitoring include collection parameters to evaluate MNA, therefore, MNA is no longer included in the alternatives in the proposed plan. The existing Institutional Controls (ICs) would continue to be maintained to control use of the area.

Figure 1: Site Location Map [Source: Figure 2.1 in Site Characterization Summary Report]

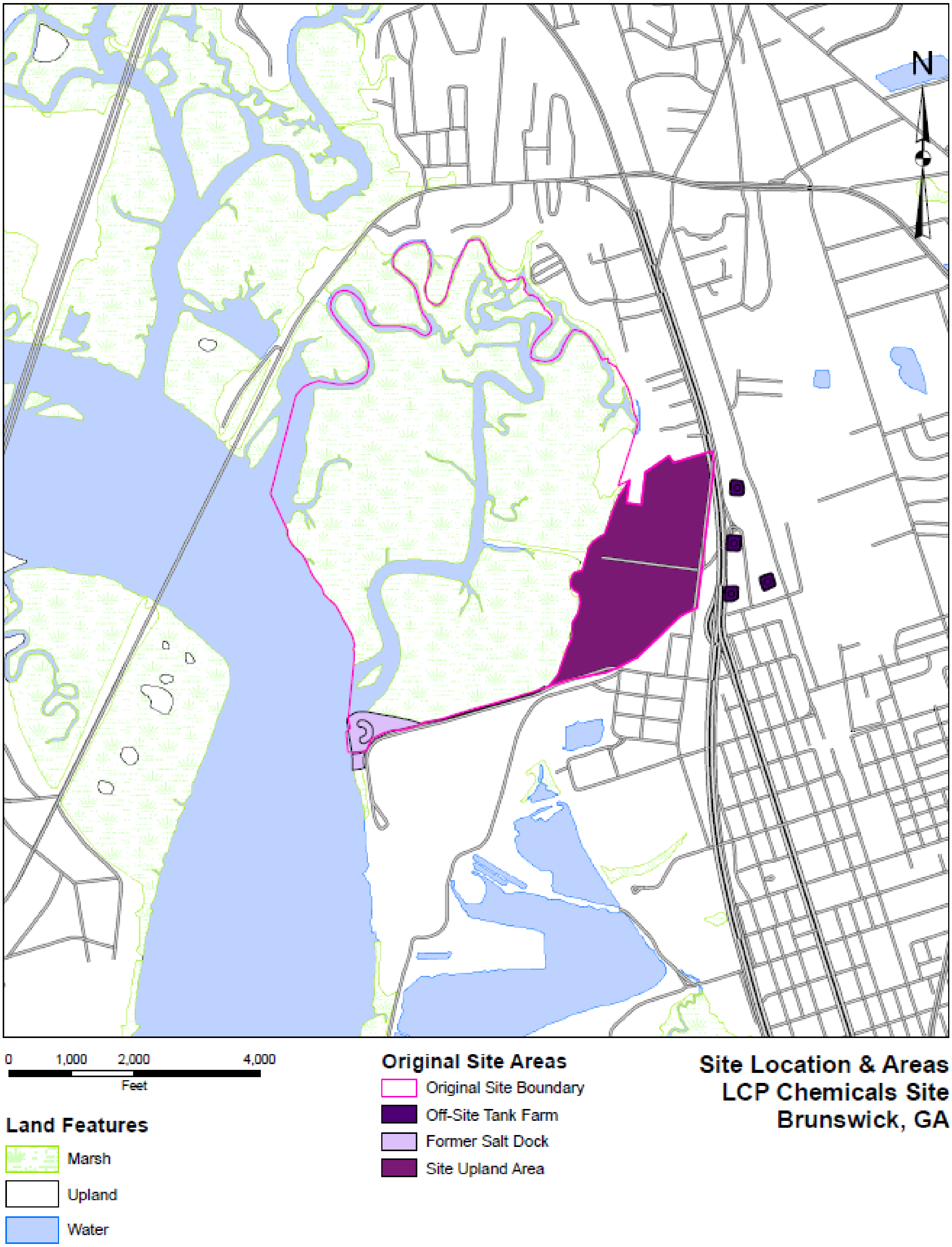


Figure 2: Historical Site Operations [Source: Figure 4 in Proposed Plan for OU3]

Site Background

The Site is located at 4125 Ross Road, just outside of the City of Brunswick, in Glynn County, Georgia, and is bordered by the Turtle River marshes to the west and south and by urban areas of Brunswick to the north and east. The Site occupies approximately 813 acres northwest of the City of Brunswick, (Figure 1), with approximately 670 acres being tidal marshland. Manufacturing operations at the Site occurred on approximately 134 acres of upland area east of the marsh. On June 17, 1996, the LCP Chemicals Georgia Site was added to the EPA's National Priorities List (NPL). The NPL listing means that the Site ranks among the nation's highest priorities for remedial evaluation and response of releases of hazardous substances, pollutants or contaminants.

In order to facilitate the investigation and remediation, the Site was divided into three OUs: the marshland portion of the Site is designated as OU1; Site-wide groundwater and all soil beneath the former CBA are designated as OU2; and the upland portion of the Site (excluding the CBA) is designated as OU3. This Interim Early Action Proposed Plan addresses the CBA portion of OU2.

History of Site Operations

A history of Site operations and contamination is presented below under three subsections: *Refinery and Power Generation Operations (1919-1955)*, *Past Manufacturing (1941-1955)*, and *Chlor-Alkali Operations (1955-1994)*.

Refinery and Power Generation Operations (1919-1955)

Atlantic Refinery Company (later Atlantic Richfield Company) (Arco) operated the Site as a petroleum refinery from 1919 to the early 1930s. At one time, over 100 process and storage tanks were present on the Arco facility with operations spanning much of the Site. Georgia Power Company purchased portions of the Site in 1937, 1942, and 1950. Power plant operations were generally centered on the upland portion of the Site (Refer to Figures 2 and 3).

Areas of operation by Arco and Georgia Power Company that reasonably contributed to groundwater contamination include what are referred to as the North and South Removal Areas, North and South Separators, and Bunker "C" Tank Area. Petroleum process **sludges** were buried in portions of the former Brunswick-Altamaha Canal (marked in purple on Figure 2). Much of the Site is also characterized by a petroleum hydrocarbon **smear zone**, which is the weathered remnants of petroleum products released in portions of the upland during this time period.

Past Manufacturing (1941-1955)

The Dixie Paint and Varnish Company (O'Brian) operated a paint and varnish manufacturing facility at the Site from 1941 to 1955 on a portion of the property south of the Georgia Power Company parcel. No information on the process operations and practices of the paint and varnish manufacturing facility is available.

Records of disposal for the Dixie Paint and Varnish Company are not available. Disposal of coatings products (i.e., paint) is inferred from the nature of soil and waste removed from a Former Facility Disposal Area during a 1994-1997 uplands soil removal action. Based on this, the disposal of coatings products is an unknown but a probable contributing factor to Site soil and groundwater contamination.

Chlor-Alkali Operations (1955-1994)

In 1955, after acquiring almost all the land constituting what is now known to be the Site, Allied Chemical and Dye Corporation (Allied) established and operated a chlor-alkali facility on a portion of the Site, principally for the production of caustic solution, chlorine gas, and hydrogen gas. The chlor-alkali facility operated using a **mercury cell process**, which involves passing a concentrated brine solution between stationary graphite or metal **anode** and a flowing mercury **cathode** to produce chlorine gas, sodium hydroxide (the caustic solution), and hydrogen gas. Sodium hypochlorite (bleach) was also produced in a secondary reaction. For a time, the graphite anodes were impregnated with the **polychlorinated biphenyl (PCB) Aroclor** 1268 to extend their use. The former chlor-alkali manufacturing operation was centered south of B-Street. Two sister buildings at this location designated Cell Building 1 (north building) and Cell Building 2 (south building) each contained an independent mercury cell process supported by a salt purification plant and additional on-site holding tanks for process liquids.

Linden Chemicals and Plastics, Inc. (LCP, owned by the Hanlin Group at the time) purchased the property and the chlor-alkali plant from Allied in 1979. The chlor-alkali process continued with modification. Part of the modification included the production of hydrochloric acid by reacting chlorine and hydrogen. LCP's operations ended on February 2, 1994.

Historical release of mercury is attributed to the loss of liquid mercury during system operation (i.e., leaks and spills) and to a lesser extent as dissolved mercury in caustic releases. Leaks and spills also occurred for liquid caustic, sodium chloride brine, and bleach. In addition, the chlor-alkali operations were supported by several on-site lagoons or impoundments used to hold manufacturing waste process liquids. The impoundments were unlined and included linear sections of the former excavated Altamaha Canal that historically traversed the western half of the Site (Refer to Figure 3). Some of these same impoundments were also used for former refinery disposal operations. The impoundment liquids/waste provided a secondary pathway to release constituents to groundwater.

Summary of Response Actions

The following is a summary of response actions that have occurred to address the above-described contamination:

In February 1994, after numerous investigations by the GAEPD and the EPA, GAEPD requested that the EPA initiate removal enforcement actions at the Site. A Unilateral Administrative Order for removal action was issued to the LCP and Allied in 1994 and amended in 1995 to include Arco, Georgia Power Company, and the O'Brien Corporation (Dixie Varnish) as additional respondents. Three **potentially responsible parties** (PRPs) (Allied (their descendant is

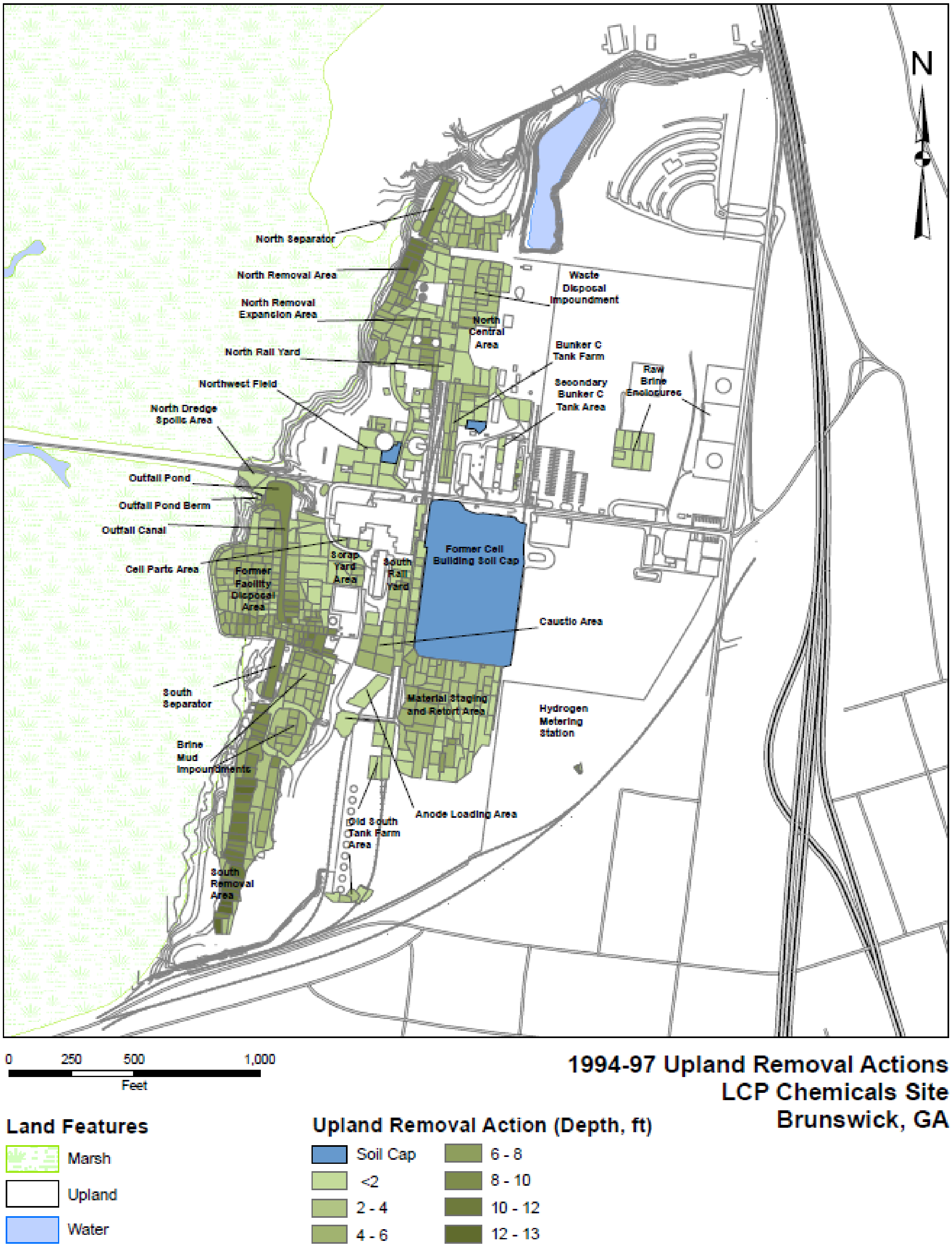
Honeywell), Georgia Power Company, and Arco) subsequently entered into an Administrative Order on Consent to conduct additional removal activities in August 1997 (the O'Brien Corporation was not included). Between 1994 and 1997, removal actions were performed by the PRPs, with EPA oversight, in the marsh, around the mercury cell buildings, and on the upland portion of the Site (see Figure 3). The removal actions included the excavation of approximately 130,000 cubic yards (CY) of contaminated soil and industrial process waste from 26 areas of the Site.

In addition, the removal action addressed areas formerly containing petroleum hydrocarbon source materials, including the North and South Removal Areas, North and South Separators, and Bunker "C" Tank Area. Both the North and the South Removal Areas contained petroleum hydrocarbon-saturated soil and petroleum tar/sludge waste. The removal activities at these two areas included excavation and off-site disposal of approximately 30,500 CY of waste. Approximately 1,240 and 1,325 CY of sludge were removed from the North and South Separators, respectively. The Bunker "C" Tank Area included petroleum hydrocarbon-saturated soil and aboveground tanks containing fuel oil, wastewater and bottom sludge. The contents of the tanks were removed, the tanks were demolished, and approximately 2,900 CY of Bunker "C" Tank Area soil were excavated and disposed off-site.

Further removal work addressed areas formerly containing mercury and mercury-contaminated alkaline sludges, including the areas referred to as the CBA, Mercury Retort Area, Caustic Tanks Area, bleach mud at the North Removal Area, lime-softening mud at the Waste Disposal Impoundment, the Brine Mud Impoundments, former Facility Disposal Area, and adjacent portions of the marsh, including tidal channels. Removal activities at the CBA resulted in the elimination of above-grade sources. This included the removal of Hg^0 from the process equipment, decommissioning and demolition of the mercury cell buildings, and placement of a soil cover over the entire CBA. At the Mercury Retort Area, the aboveground concrete structures and soil and retort waste that were contaminated with mercury were excavated and disposed of off-site. Aboveground tanks and approximately 2,500 CY of soil contaminated with mercury and caustic were removed from the Caustic Tanks Area. The alkaline sludges contaminated with mercury included the bleach mud, lime-softening mud, and brine mud. Removal of these contamination sources was accomplished by excavating and disposing a total of approximately 37,000 CY of process wastes from the North Disposal Area, Waste Disposal Impoundment, and Brine Mud Impoundments.

Finally, conditions at the CBA, which encompassed the former mercury cell process operations, resulted in the release of caustic and brine solutions into the groundwater, a mixture which has historically been referred to as the caustic brine pool (CBP). Under the terms of an Administrative Settlement Agreement and Order on Consent for Removal Action, four phases of carbon dioxide sparging treatment were conducted between 2013 and 2019 to address this groundwater contamination, with the primary goal of reducing the high **pH** of the groundwater. A benefit resulting from the lowering of the groundwater pH was a corresponding reduction in certain dissolved-phase metals concentrations including mercury.

Figure 3: Upland Removal Actions, 1994-1997 [Source: Figure 2.5 in Site Characterization Summary Report]



Site Characteristics

As noted previously, the Site consists of approximately 813 acres, of which approximately 670 is marshland. The main feature of the marsh is Purvis Creek, which divides the marshlands roughly in half, north to south. Purvis Creek flows into the Turtle River. Manufacturing operations at the Site occurred on approximately 134 acres of upland area east of the marsh.

Site Geology and Groundwater

The uppermost portion of the sedimentary deposits of sands, silts, and clays underlying the Site comprise the **Satilla Formation**. The Satilla Formation is underlain by the sands, silts and clays of the **Ebenezer Formation**. A variably cemented sand layer is sometimes present at the base of the Satilla between the two formations. Contaminated groundwater is centralized in the shallow Satilla Formation, with leakage of contaminants to the upper Ebenezer Formation. Regional confining layers isolate the Site contamination from regional water supply aquifers. For the OU2 **human health risk assessment** (HHRA) (discussed further under the "Site Risks" section), Site-wide groundwater was evaluated as two main **exposure units** (EU). The EUs are vertically defined as shallow surficial groundwater in the Satilla Formation and deep surficial groundwater in the Ebenezer Formation. However, due to the Site history, the differences in uses of the north and south areas of the Site and the differences in groundwater COCs in the north and south areas of the Site, the Satilla was evaluated as two separate sub-EUs, the North Satilla and the South Satilla. This information is further described in the RI/BRA and FFS. The groundwater for the entirety of OU2 seems to show impacts from the former refinery operations. However, the north areas of the Site are not impacted by the caustic brine release and have a different COC footprint from the south areas of the Site. The south areas of the Site show impacts from the caustic release in groundwater and inorganic COCs are more prevalent in the south areas as a result.

A soil cover of one and a half to two feet thickness is in place over the entire six-acre CBA. Hg^0 remains present in the subsurface as discrete beads, and it occurs primarily in the southwest extent of each former cell building footprint (Figure 4a). Mercury has been detected in soil core samples from near surface to the base of the Satilla Formation (approximately 50 feet below ground surface (bgs)). **Polynuclear aromatic hydrocarbons** (PAHs) are also present throughout the CBA and generally occur at their highest concentrations from 8to 15 feet bgs, a lower depth limit which corresponds to a probable petroleum smear zone caused by historical water table fluctuations. The former concrete foundations of the cell building remain in place, and a clean backfill soil cover was placed over the entirety of the CBA in 1997, along with a security fence encompassing this area. The HHRA evaluated surface soil and a mixed zone comprised of surface soil and subsurface soil in the CBA as the EUs that encompasses the footprint of the CBA soil cover.

Scope and Role of Response Action

The Site was divided into three OUs: the marshland portion of the Site is designated as OU1; Site-wide groundwater and all soils beneath the former CBA are designated as OU2; and the upland portion of the Site (excluding the CBA) is designated as OU3.

This Proposed Plan addresses the CBA portion of OU2. A remedy was previously selected for OU1 in 2015 and a No Action Decision was determined for soil at OU3 in 2020.**Remedial Investigation**

Nature and Extent of Groundwater Contamination

Groundwater data from the most recent sampling events in 2017, 2018, 2019, and 2020 were evaluated to select constituents to capture the current nature and extent of the groundwater contamination. A Site-wide groundwater sampling event was performed in 2017 with more targeted sampling (generally in the CBA study area) in 2018, 2019, and 2020 to assess changes resulting from the carbon dioxide (CO_2) sparging treatment and to address EPA identified data gaps.

A discussion of the nature and extent of groundwater COCs requires reference to the CBP as the occurrence and profile of many COC are inherently linked to the unique geochemical setting that developed following the release of caustic and brine. The release of caustic and brine solutions resulting in the CBP is marked by several direct indicators including pH, sodium, and chloride. The evaluation of the CBP and its progression since the inception of the RI characterization is summarized herein based on changes in these three parameters.

Benzene, toluene, ethylbenzene, and xylenes (BTEX), and benzene-based compounds are the most frequently detected **volatile organic compounds** (VOCs) in groundwater and account for nine of the top ten detected VOCs. Chlorinated carbon compounds are less frequently detected and tend to occur in fewer Site monitoring wells. Of the VOCs detected from 2017 to 2020, only benzene and chlorobenzene had reported exceedances of a groundwater standard in >10% of groundwater samples. In general, with only a few exceptions, VOCs are detected more frequently in the shallower depths of the Satilla Formation, and most VOCs exhibit a non-detect condition below the variably cemented sandstone layer. However, trace levels of BTEX and benzene-based compounds are detected in the deeper wells below the variably cemented sandstone layer with more miscible VOCs (toluene, carbon disulfide, acetone) exhibiting a higher frequency of detection at depth. Further detail on the detections and distribution of VOCs is provided in the OU2 RI Report. VOC COCs will be addressed in the future final ROD for OU2.

PAHs are detected across all interval depths in the Satilla. The higher concentrations of PAHs occur in wells located along or near the marsh-upland border near known petroleum sources associated with the former canal and west of the CBA. This is the area that is also characterized by a weathered petroleum smear zone (refinery operations occurred across the CBA footprint). Of the PAHs detected from 2017 to 2020, three constituents exceed a groundwater benchmark in >10% of groundwater samples: benzo(a)anthracene, naphthalene, and 1-methylnaphthalene. Further detail on the detections and distribution of these three PAHs is provided in the OU2 RI Report. PAH COCs will be addressed in the future final ROD for OU2.

Organic constituent exceedances of groundwater benchmarks tend to occur most frequently in the shallower aquifer settings and decrease with depth, but metal constituents tend to occur with a greater frequency above groundwater benchmarks in the Middle and Lower Satilla settings.

The differences in distribution between organic and metal constituents is attributed to the constituent source, fate, and transport properties. The source of the metals requires consideration of anthropogenic and geologic origins. The detection of metals in groundwater from potential geologic origins is influenced by the chemical properties of past caustic and brine releases and the lingering effects following CO_2 treatment of the high pH condition. Metals directly related to former industrial operations include mercury (chlor-alkali operations), lead (refinery operations), and vanadium (refinery operations). Most of the other metals are found in trace quantities in heavy minerals and silicates (arsenic, chromium, iron and titanium oxides, iron sulfides, and silicates), which are common along the Georgia coast and locally make up as much as a few percent of the surficial aquifer sand. The presence of the naturally occurring heavy minerals in the aquifer matrix is confirmed based on the spectroscopic investigations summarized in the OU2 RI Report.

The evaluation of groundwater metals data from 2017 to 2020 identified ten metals that exceed a groundwater benchmark in >10% of groundwater samples. The spatial distribution and condition of seven of the ten metals are presented in the OU2 RI Report and include arsenic, beryllium, chromium, lead, mercury, selenium, and vanadium. The remaining three metals, aluminum, iron, and manganese are major components of the natural aquifer matrix and are not examined.

Nature and Extent of CBA Shallow Unsaturated Soil Contamination

Between 1994 and 1995, two investigations performed as part of the upland removal response action targeted shallow soil across the footprint of the CBA (prior to placement of the soil cover). The investigations included the collection of shallow soil with a hand auger, either in the soil adjacent to each cell building or beneath the building after coring through the concrete foundation slabs. Soil samples were tested for metals, VOCs, PAHs, and PCBs. In 1995, the soil study was expanded to include mechanical excavation (i.e., test pits) in areas of interest to allow for a more thorough assessment of the sub-foundation soil condition. The test pit program included a visual assessment of the soil for Hg^0 and analytical testing for mercury, lead, VOCs, PAHs, and PCBs.

The soil cover thickness was evaluated as part of an OU2 RI data gaps review, specifically to identify portions of the CBA where the cover thickness was less than 2 ft bgs in order to facilitate additional surface soil (i.e., upper 2 ft) sampling to support the HHRA. The soil cover thickness was determined by comparison of 1994 topographic surface mapping (pre-cover) to 2006 **light detection and ranging** (LiDAR) topographic mapping (post-cover), generating an interpolated digital terrain map of the CBA. Soil cover thickness is generally 1.5 to 2+ ft across the majority of the CBA – peripheral areas are less thick, and these areas were targeted for the HHRA shallow soil sampling.

In 2020, Montrose (a contractor for the PRPs) began the process of developing the framework for the CBA soil risk assessment. In the framework development phase and discussion with the EPA, a data gap was determined regarding the characterization of surficial soil (i.e., the top 2 ft of the soil horizon) due to the existence of the soil cover across most of the CBA. In response, the 2021 CBA surface soil assessment was completed. The 2021 surface soil assessment targeted the original surface soil beneath the imported soil cover (i.e., sampling generally performed in the 1.5-2 ft-bgs interval). The native soil samples were analyzed for VOCs, PAHs, **target analyte list** (TAL) metals including Hg, and PCBs.

Surface soil VOCs were generally non-detect except for trace level toluene. Several PAHs were detected in the surface soil layer with a greater frequency of detection and higher concentration generally along the northern extent of the CBA. PCBs were detected in all samples with the highest detections occurring along the southern extent of the study area. No consistent patterns are noted for the metals, but the mercury profile is generally consistent with the PCB profile (i.e., highest detections are co-located).

Nature and Extent of CBA Shallow Saturated Soil Contamination

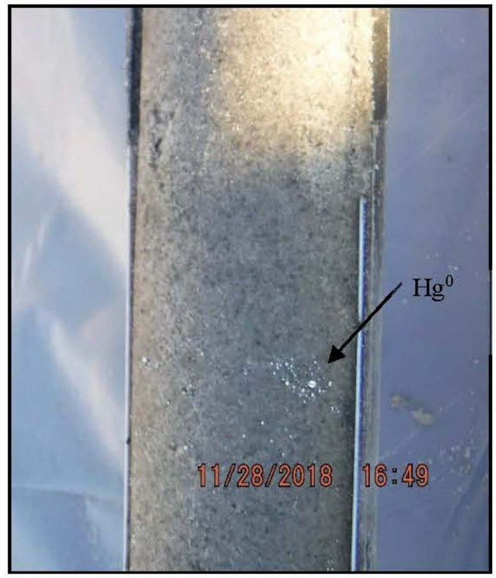
The 2018 CBA characterization work also included sampling and testing of soil across the CBA beneath the cell building slabs (in the saturated zone). Most of the soil boring locations across the CBA identified a hydrocarbon smear zone laterally continuous across much of the CBA and vertically to a depth of approximately 8 to 15 ft bgs, a condition confirmed by the PAH testing. The most commonly detected and highest concentration PAHs were naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene, and this PAH soil condition is reflected in Site groundwater west of the CBA. Sample depths varied from 4 to 16 ft bgs (all below the water table). No PAHs exceeded the industrial screening level for soil, indicative of a highly weathered residual hydrocarbon (refining operations ceased more than 90 years ago). A summary of the PAH testing data is provided in the OU2 RI Report.

Mercury Release and Extent in the Subsurface

The release of caustic brine altered the geochemistry of the groundwater as well as the solid mineral phases of the Satilla formation. The primary impact of the caustic brine release was the increase in pH (up to ~14) and sodium concentrations in groundwater. At elevated pH conditions, the dissolution of the silica matrix of the Satilla Formation is greatly enhanced, as are other mineral phases, resulting in a remarkable increase in dissolved silica content and silica colloid formation in groundwater not observed under most natural conditions. A consequence of the enhanced silica solubility and mineral breakdown at the caustic release area was a weakening of the load-bearing capacity of the underlying soil causing subsidence beneath the former cell buildings. The subsidence caused the concrete foundations and ground-level trough system, designed to channel and collect process fluids including Hg^0, to pitch and crack, thus allowing a pathway for spilled caustic and Hg^0 to penetrate the Satilla Formation.

Both cell buildings required the retrofit installation of structural support pilings in the later 1980s and pouring of a second layer of slab foundation. The process of pile driving into the subsurface may have further facilitated transport of the Hg^0 to greater depths due to vibration and piling-induced scrape channels during installation.

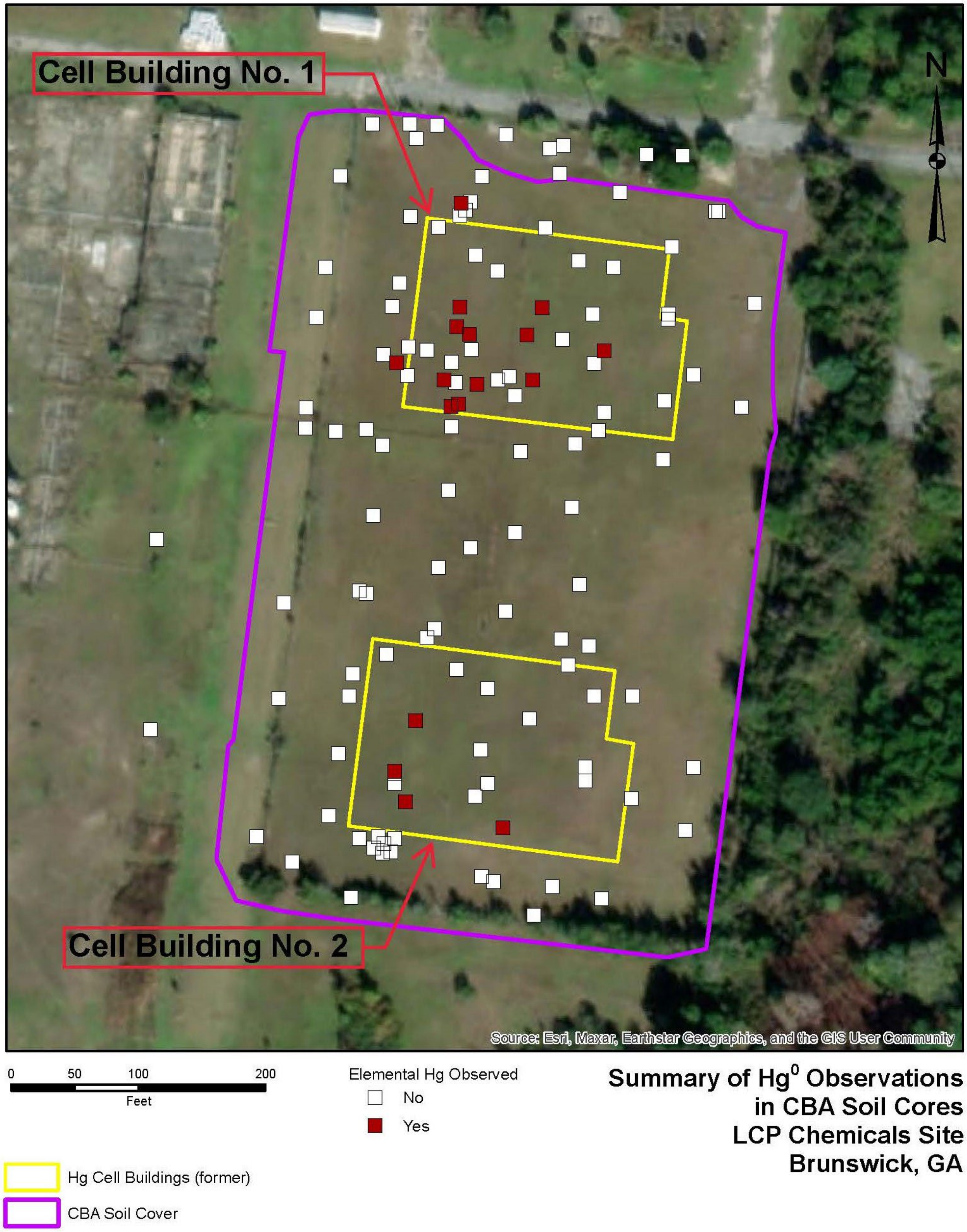
The combination of the 1997 and 2018 CBA soil core programs fully delineated the Hg^0 extent in the Satilla Formation. The assessment of Hg^0 was performed primarily through visual assessment (i.e., presence of beads of Hg^0) but included laboratory testing for mercury concentration as detailed in the OU2 RI Report. The soil core borings revealed Hg^0 to be present as small discrete droplets observed in the vicinity of the subsidence area beneath Cell Building 1 and at shallow depths along the southern side of Cell Building 2. In the subsidence area, discrete droplets of Hg^0 were observed to a depth of 50 ft-bgs.



In all assessments, Hg^0 has been observed as small discrete droplets in the soil matrix and ranged from 20 micrometers to 2 millimeters in size (see inset), and no pooled Hg^0 was observed in the subsurface soil matrix. (Note that accumulations of recoverable Hg^0 were present between the concrete slabs of Cell Building 1. The recoverable Hg^0 was removed during the Cell Building decommissioning.) The Hg^0 droplets were not uniformly distributed across the depth of the Satilla but were found as droplets occurring in the aquifer sands at the interface of well sorted sand lenses perched atop a layer of low permeability clay or silt. No Hg^0 beads were observed in tighter clay layers.

The distribution of Hg^0 droplets was described as Hg^0 bead stringers that were typically less than 1 inch thick but sometimes ranged up to 3 inches thick. The discrete droplets of Hg^0 entrained in the sands are unlikely to undergo further vertical transport with current Site conditions and use. The cohesive nature of the Hg^0 beads would also slow or retard permeation of Hg^0 through the sandstone. However, changes in Site use could impact these conditions and facilitate transport if the beads are not addressed. The distribution of Hg^0 in the CBA is shown in plan view on Figures 4a and 4b (total distribution in 4a and by depth in 4b). Outside the footprint of the building (i.e., north of Cell Building 1) and away from the former piling activity, Hg^0 found was limited to the top few feet of the soil column. Mercury is detected in subsurface soils in other forms as well. Mercury is also present in in the groundwater in a dissolved phase.

EPA considers the Hg^0 droplets to represent a highly toxic source material at the Site. These source materials constitute principal threat wastes at the Site. As such, it is EPA's expectation and goal to consider remedies which involve treatment of source materials constituting principal threat wastes (NCP §300.430(a)(1)(iii)(A)). Remedies which do so satisfy the statutory preference for treatment as a principal element.



Summary of Hg^0 Observations in CBA Soil Cores LCP Chemicals Site Brunswick, GA

Figure 4b: Summary of Hg^0 Observations by Depth [Source: Figure 6.4 in OU2 RI Report]

Cell Building Area Mercury Vapor Assessment

In July 2022, testing of vapor emissions assessment in the CBA was conducted to evaluate the efficacy of the soil cover in preventing the atmospheric release of potential emissions from the Hg^0 condition beneath portions of the former cell buildings.

The study followed a systematic sampling design across the CBA at 50-foot centers with a triad of measurements collected at each monitoring station, including: measurement of ambient air from the breathing zone (i.e., approximately five feet above ground surface); measurement of ambient air adjacent to the ground surface; and measurement of soil gas within the soil cover. Measurements were also collected at a background location selected as the administrative building along the eastern property boundary. Hg^0 vapor concentrations in soil gas, at the ground surface, and in ambient air (i.e., the breathing zone) are presented in the FFS Report and were found to not present a concern under current conditions.

Contaminant Origin, Fate, and Transport

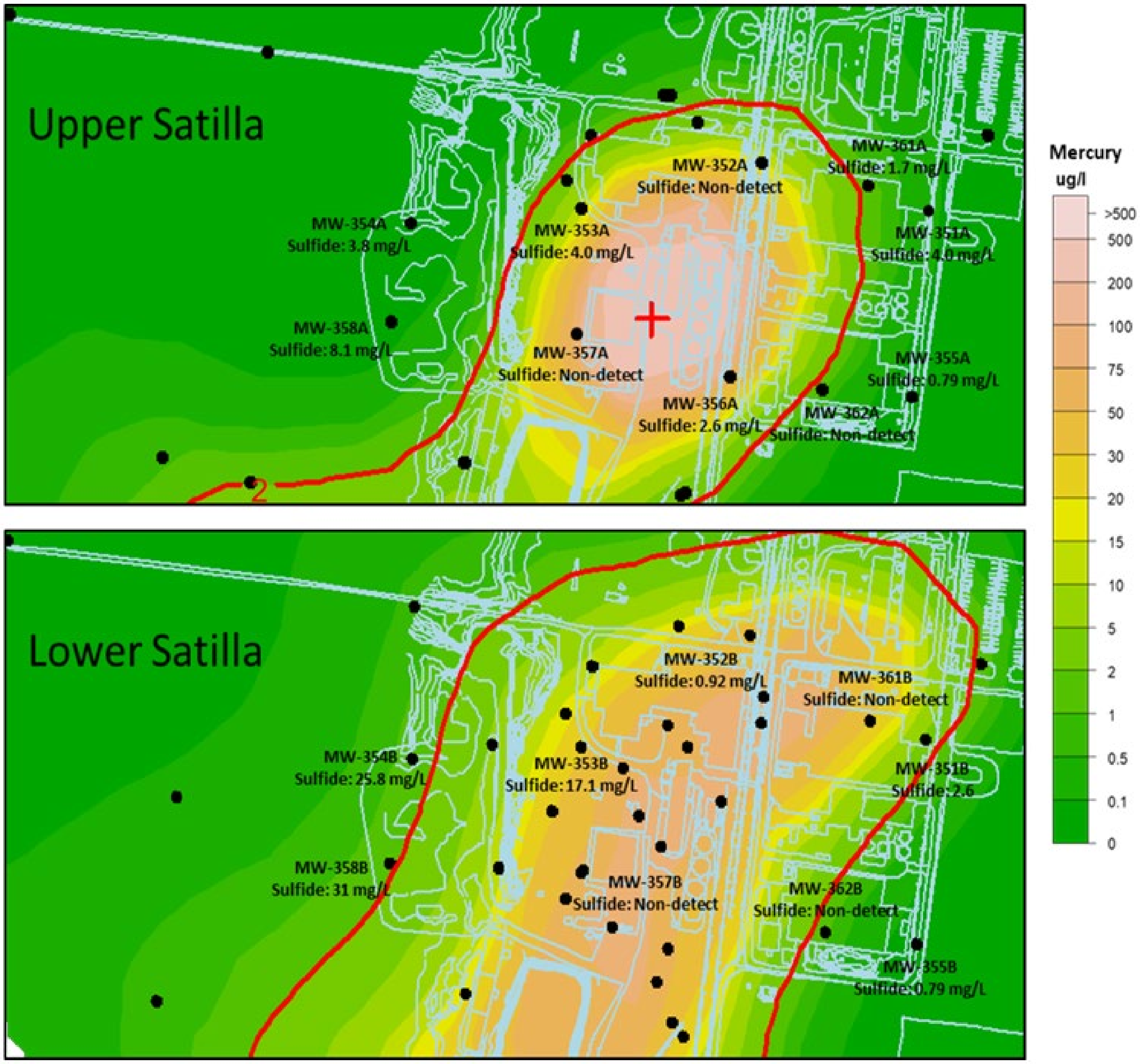
The occurrence and distribution of contaminants in groundwater is usually approached from a direct anthropogenic cause-and-effect dynamic, i.e., the release of a contaminant results in contamination by that contaminant. This describes the occurrence of several Site COCs that are associated with specific historical operations. Examples of Site-specific constituents that have a known association with specific historical operations include mercury from the chlor-alkali operation and petroleum hydrocarbons, lead, and perhaps vanadium from the past refinement of crude oil. Other Site COCs have an unknown anthropogenic source but correlate spatially with past Site operations or the historical release of process fluids, such as the caustic brine and likely releases of mercury through the cracks in building foundations because of subsidence, most notably metals in the CBP or near process waste disposal areas. These other COCs, based on their physical-chemical properties, are thus interpreted as a probable secondary effect caused by the Site's substantially altered geochemical setting brought about by the historical release of process fluids. It has been noted during groundwater sampling after the CO_2 injections that levels of other inorganic COCs have also decreased as the groundwater has returned to the natural neutral pH state. Determining which COCs remain above protective levels will be a focus for the periodic groundwater monitoring effort and will be a focus for the final action for OU2.

Prior to the Site's release of process fluids and the formation of the highly altered geochemical setting termed the CBP, the Satilla and Ebenezer Formation likely exhibited neutral to slightly acidic groundwater (based on samples from the Site's eastern most (i.e., up-gradient) monitoring wells) and an elevated total dissolved ion content typical for the coastal marsh-upland setting.

The release of the brine and caustic destabilized the aquifer's baseline condition and geochemistry resulting in a physical-chemical redistribution of metals and ions (including any released metals from historical operations) that resulted in the contamination discovered and evaluated during the early RI phases of the mid-1990s. Transportation of Mercury and other metals are facilitated by the solubilized organic matter and potentially by silica colloids within the CBP, but upon exiting the CBP in a dissolved state in the groundwater, several metals (e.g., mercury and arsenic) exhibit a stark concentration break or decrease in detected dissolved levels, indicating adsorption and precipitation pathways are attenuating their condition more so than other metals. The sharp concentration break near the marsh-upland border is reasonably facilitated by the formation of insoluble metal sulfides, mercuric sulfide and arsenic sulfides. The thermodynamic modeling of phases in the OU2 RI Report found the mercury and arsenic sulfides to be the most oversaturated phases in former CBP-impacted groundwater as the pH condition is moderated. Localized depletion in sulfide at the caustic brine pool margin provides an additional line of evidence supporting this conclusion. Figure 5 depicts the dissolved mercury concentration profile in the Upper and Lower Satilla in 2012 prior to commencing CO_2 sparging and the most recent data set for dissolved sulfide.

The recent CO_2 sparging treatment has neutralized the CBP and moderated the geochemical setting, initiating a second redistribution of metals and other dissolved constituents. The change in pH has allowed for metals and some other dissolved constituents to return to their natural state and precipitate out of the groundwater to bind with aquifer solids or saturated soil. The return of the groundwater to more natural and neutral pH levels indicate these constituents will remain permanently in a solid form as long as the groundwater in the aquifer continues to be in the natural neutral pH state and will not contribute to the groundwater contamination. The redistribution has been rapid for some constituents (e.g., mercury) following the CO_2 sparging treatment, while others have displayed a more gradual to limited improvement in the couple of years since completion of the treatment. The fate of specific COCs with respect to changes in groundwater chemistry following the CO_2 sparging treatment and natural recovery processes is discussed further in the OU2 RI Report. While it is anticipated that the groundwater will remain in the natural neutral pH state, periodic groundwater monitoring will be done to confirm the state of the groundwater and any elevated metals above protective levels will be addressed in the final remedy for OU2.

Figure 5: Dissolved Mercury and Sulfide CBA Concentrations [Source: Inset in Section 6.3.4.2.2 of the FFS Report]



Note the historical concentration drop in dissolved mercury occurred near the marsh upland border west of the CBA. Corresponding to the marsh upland boundary is a historical increase in the dissolved sulfide typically increasing from a few milligrams per liter (mg/L) or less to greater than 20 mg/L in the Lower Satilla. Sulfide concentration is provided in the well label. The intersection of high sulfide and the dissolved mercury front is interpreted to be one pathway for the attenuation of mercury with potential formation of mercuric sulfide. The estimated mercury **Maximum Contaminant Level** (MCL) of 2 µg/L is shown as the red line.

Summary of Site Risks

An HHRA was conducted, and the findings are summarized in the OU2 RI Report, which is available in the AR for this OU2 Interim Action Proposed Plan. After the HHRA for the OU2 RI was submitted and finalized, an additional risk evaluation was conducted to specifically assess the health risks from the potential use of portions of the Site as a recreational golf course. The separate evaluation and findings are also available in the AR. The results of the ecological risk assessment for OU3 are not pertinent as an ecological risk assessment is not warranted for OU2. There is no reasonable ecological exposure to the groundwater condition for all of OU2, and the CBA is also covered with clean fill soil to a thickness precluding ecological exposure. In addition, ecological impacts to the salt marsh from the Site contaminants were assessed for OU1 and have been addressed in the remedial actions taken for OU1. Ecological impacts for OU3 were also assessed after the earlier removal actions done between 1994 and 1997 and in the 2013 Remedial Investigation for OU3 and found to not warrant further remedial action as stated in the 2020 ROD for OU3.

What is Risk and How is it Calculated?

A Superfund baseline risk assessment is an analysis of the potential adverse effects caused by hazardous substances at a site under current and future conditions in the absence of any actions to control or mitigate these effects. Both the human health risk assessment (HHRA) and baseline ecological risk assessment (BERA) have four main components used for assessing site-related human health or environmental risks:

Hazard Identification (used in an HHRA) or Problem Formulation (used in a BERA): In the Hazard Identification step, the potential COCs in soil 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 soil and mobility, persistence, and bioaccumulation. In the Problem Formulation component of the BERA, potential COCs are identified, ecological effects and exposure pathways are reviewed, assessment endpoints are selected, and a conceptual model is developed.

Exposure Assessment: In this component, the different exposure pathways through which receptors (people and animals) might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil. Factors relating to the exposure assessment include, but are not limited to, the concentrations that people or wildlife might be exposed to and the potential frequency and duration of exposure.

Toxicity or Effects Assessment: In this component, the types of adverse health effects associated with chemical exposures and the relationship between the 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 non-cancer health effects, such as changes in the normal functions of organs within the body (e.g., changes in the effectiveness of the immune system) or reproductive effects. Some chemicals are capable of causing both cancer and non-cancer health effects.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks. In an HHRA, exposures are evaluated based on the potential risk of developing cancer and the potential for non-cancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 1E-04 cancer risk would mean a one-in-ten-thousand excess cancer risk to an exposed individual, or that one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions explained in the Exposure Assessment. Current federal Superfund guidelines for acceptable exposures are “generally concentration levels that represent an excess upper bound cancer to an individual of between 1E-04 to 1E-06” (40 Code of Federal Regulations [CFR] § 300.430[e][2](i)[A][2]); corresponding to a one-in-ten-thousand to a one-in-a-million excess cancer risk. The 1E-06 risk is used as the point of departure for determining remediation goals. For non-cancer health effects, a "hazard quotient" (HQ) is calculated for each contaminant. An HQ represents the ratio of the estimated exposure to the corresponding **reference doses** (RfDs). The sum of the HQs is termed the "hazard index" (HI). The key concept for a non-cancer HI is that a "threshold level" (measured as an HQ or HI of 1) exists, below which non-cancer health effects are not expected to occur. In a BERA, risks to the environment are evaluated using individual contaminant HIs calculated for representative receptor species.

The HHRA considered the various ways that humans might be exposed to Site chemicals, the possible concentrations of chemicals that could be encountered during exposure, and the potential frequency and duration of exposure (referred to as **exposure scenarios**). These exposure scenarios are based on the current and the reasonably anticipated future use of the land and groundwater consider the sensitive sub populations for anticipated future exposure.

At the time the HHRA was conducted, based in part on the Basic Industrial zoning of the Site, the anticipated future land use was commercial/industrial. The EPA does not anticipate future residential use of any portions of the Site and ICs are already in place prohibiting residential use of the Site, per the 1990 removal action memorandum. Accordingly, exposure scenarios considered by the HHRA related to commercial/industrial use of the Site. An additional risk evaluation was conducted after the HHRA was finalized to assess a new proposal to develop the Site as a recreational golf course. Discussion of that later assessment can be found after the following discussion of the HHRA.

Exposure Scenarios considered by the HHRA

The EPA does not anticipate future residential use of the upland soil at the Site, and ICs are in place prohibiting residential use of the Site. Accordingly, any exposure to contaminated groundwater is likely limited to excavation workers involved in future construction or maintenance at the Site. Nevertheless, the HHRA conservatively assumed use of groundwater by a hypothetical on-site resident (residential **receptor**). In addition, subsurface disturbance of the CBA will be performed by informed and properly trained personnel using appropriate protective gear given the Site risks per the existing IC, and limited to minor reworking of the soil cover or addition of hardscape surface (e.g., parking or surface storage). Given the existing clean soil cover depth, which ranges from one and half to two feet except at the soil cover perimeter, any exposure to the CBA soil condition is likely limited to excavation workers. Nevertheless, the HHRA assumed residential exposures to the limits of available shallow soil at the soil cover perimeter in order to be conservative.

Routes of exposure evaluated in the HHRA include ingestion of soil and groundwater, dermal contact with soil and groundwater, and inhalation due to emission of fugitive dust or volatilization of contaminants from soil or groundwater.

Human health risk is classified as cancer risk (from exposure to carcinogens) or non-cancer hazard (from exposure to non-carcinogens). Cancer risk is an estimated probability that a person will develop cancer from a scenario specific exposure to Site contaminants over a 70-year lifetime. To be conservative in evaluating cancer risks, contaminants were screened based on a cancer risk of 1 in 1,000,000 in the quantitative HHRA. This value represents the lower end of the **risk management range** of 1 in 1,000,000 (expressed as 1x10-6) to 1 in 10,000 (expressed as 1x10-4). A probability of 1 in 1,000,000 is the risk that for every 1,000,000 people, one additional cancer case may occur as a result of exposure to Site contaminants.

Non-cancer hazard is the potential for experiencing adverse health effects other than cancer and is expressed numerically in terms of the **hazard index**. A cumulative hazard index of 1 or less is considered an acceptable exposure level. To be conservative in assessing non-cancer health hazards, areas at the Site with a hazard index greater than 1 were evaluated in the RI Report and the Recreational Use Risk Assessment in the FFS.

As is explained more fully below, the HHRA found unacceptable risks from both soil and groundwater to a hypothetical resident and to an excavation worker, supporting the need for remedial action.

Table 1: Summary of Hazard/Risk Calculations
[Source: Tables 7.15 and 7.31 in OU2 RI Report]

Receptor	Exposure Medium	HI	Cancer Risk
South Satilla			
Excavation Worker	Vapor	0.6	6E-06
Child Resident	Groundwater	30	3E-03
Adult Resident		20	
North Satilla			
Excavation Worker	Vapor	6	3E-05
Child Resident	Groundwater	60	2E-03
Adult Resident		40	
South Ebenezer			
Child Resident	Groundwater	20	2E-03
Adult Resident		10	
OU2 Soil			
Child Resident	Surface Soil	5	3E-05
Adult Resident		0.6	
Current Trespasser		0.1	4E-07
Future Trespasser		0.1	9E-07
Commercial/Site Worker		0.4	6E-06
Excavation Worker	Mixed Soil*	8	5E-06

Notes: Values rounded to one significant figure
Excavation Worker is equivalent to a construction worker and Commercial Site Worker is equivalent to an Industrial Worker
*Mercury exposure assumed as mercury salts
[shaded] HI > 1 or Cancer Risk > 10^{-4}

Remedial actions are proposed at the Site areas where the summed cancer risks to any receptor from exposure to contaminated soil and groundwater are greater than 1 in 10,000 or when a non-cancer hazard index for any receptor is greater than 1. **Site Specific Remedial Goals** (SSRGs) were calculated for those receptors for COCs that were significant contributors to exceedances of risk thresholds. These SSRGs are tabulated in the OU2 RI Report (noted as RGOs or Remedial Goal Options in the RI Report).

OU2 HHRA Groundwater Summary

The HHRA for Site-wide groundwater evaluated the maximum beneficial use of groundwater, namely groundwater as a drinking water source for hypothetical residents. EPA guidance provides that the intent of a risk evaluation is to determine the potential risks based on the current environmental condition. In accordance with the data selection process approved by the EPA, groundwater data was handled in different ways for the contaminants of potential concern (COPC) screening and for calculation of the **exposure point concentration** (EPC). The COPC screening was conducted using the 2017-2020 dataset, with preference to the most recent results. This was especially important in the CBP area where CO_2 treatments resulted in an improvement in the condition. The COPC screening process, exposure assessment, and chemical specific parameters are discussed in detail in the OU2 RI Report.

North Satilla, South Satilla, and South Ebeneezer groundwater exposure units were evaluated separately for health risks from exposure by commercial Site workers, hypothetical child and adult residents and excavation workers. All exposure units exceeded the risk thresholds (cancer risk greater than 1x10-4 and a non-cancer hazard index greater than 1) for the child and adult hypothetical resident. The excavation worker exposure to groundwater exceeded an HI of 1 but was within the target risk range for cancer.

OU2 HHRA Soil Summary

All of the 2020 contaminant data were factored into the CBA HHRA. The COPC screening process followed the same process as used for Site-wide groundwater. The potential COC screening process, exposure assessment, and chemical specific parameters are discussed in detail in the OU2 RI Report.

The HHRA for soils at the CBA evaluated exposure of commercial Site workers, trespassers, and hypothetical residents to surface soil and excavation workers to a mixed zone comprised of surface and subsurface soil. The results for the Site workers and trespassers did not exceed the acceptable risks (cancer risk greater than 1x10-4 and a non-cancer hazard index greater than 1). However, the results indicated a noncancer hazard greater than 1 for the hypothetical resident and the excavation worker and the non-cancer hazard index exceeded 1 for the excavation worker. Due to these risks, a remedial action is necessary to protect public health from the actual releases of mercury and other contaminants of concern into the environment.

Cell Building Area Mercury Vapor Risk Assessment

Vapor intrusion risk was evaluated based on a comparison of mercury vapor measurements to **Vapor Intrusion Screening Levels** (VISLs). The VISL Calculator is a tool developed by EPA for determining risk-based screening level concentrations for indoor (i.e., ambient) air and "near-source" soil gas concentrations. The primary objective of the risk-based screening is to identify and define areas and conditions that are unlikely to pose a health concern through the vapor intrusion pathway. Generally, at properties where subsurface concentrations of vapor-forming chemicals, such as those in near-source soil gas, fall below the VISLs, no further action or study is warranted based on the vapor intrusion pathway.

VISLs for Hg^0 in ambient air and near-source soil gas, protective of a commercial Site worker receptor, were computed using the inputs from the CBA HHRA. Hg^0 vapor concentrations in soil gas, at the ground surface, and in ambient air (i.e., the breathing zone) are presented in the FFS Report. Hg^0 vapor concentrations in soil gas, at the ground surface, and in ambient air demonstrate the efficacy of the existing soil cover in mitigating Hg^0 vapor emissions and provide multiple lines of evidence indicating that the CBA does not pose unacceptable risks for Hg^0 vapor. As a result, the RAO for mercury vapor is not necessary and is not presented in this Proposed Plan. While the soil cover is effective at mitigating Hg^0 vapor emissions and needs to remain in place and be maintained as a result, it also prevents direct contact with the original surface soils that underly the cover and will be thickened at the edges of the CBA to maintain that direct contact barrier.

Soil COCs from the results of the RI: Hexavalent chromium, Hg^0, mercury salts, and PCBs.

Groundwater COCs from the results of the RI: Aluminum, Antimony, Arsenic, Beryllium, Chromium VI, Cobalt, Iron, Manganese, Mercury, Methyl mercury, Selenium, Thallium, Vanadium, 1,2,4-Trichlorobenzene, 1,4-Dichlorobenzene, 1-Methyl Naphthalene, 2-Methylnaphthalene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Naphthalene, 1,1,2-Trichloroethane, 1,1-Dichloropropene, 1,2,3-Trichloropropane, 1,2,4-Trimethylbenzene, 1,2-Dibromo-3-chloropropane, 1,2-Dibromoethane, 1,2-Dichloropropane, 1,3,5-Trimethylbenzene, 2-Hexanone, Benzene, Bromodichloromethane, Chlorobenzene, Ethyl benzene, Isopropylbenzene, m&p-Xylene, o-Xylene, Trichloroethene, Vinyl chloride.

Remedial Investigation Groundwater COCs			
Aluminum	Antimony	Beryllium	Chromium VI
Cobalt	Selenium	Antimony	Arsenic
Iron	Manganese	Mercury	Methyl mercury
Thallium	Vanadium	1,2,4-Trichlorobenzene	1,4-Dichlorobenzene
1-Methyl Naphthalene	2-Methylnaphthalene	Benzo(a)anthracene	Benzo(a)pyrene
Benzo(b)fluoranthene	Dibenzo(a,h)anthracene	Naphthalene	1,1,2-Trichloroethane
1,1-Dichloropropene	1,2,3-Trichloropropane	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane
1,2-Dibromoethane	1,2-Dichloropropane	1,3,5-Trimethylbenzene	2-Hexanone
Benzene	Bromodichloromethane	Chlorobenzene	Ethyl benzene
Isopropylbenzene	m&p-Xylene	o-Xylene	Trichloroethene
Vinyl chloride			

Golf Course Redevelopment Risk Evaluation

After the RI and HHRA were completed, a second risk evaluation was performed for potential commercial/recreational redevelopment to convert the Site to a golf course. The land to be included in this potential redevelopment includes the high-ground land owned by Honeywell (one of the Potentially Responsible Parties or PRPs) (approximately 87 acres) and a portion (11 acres) of the 33 acres of the Site purchased by Glynn County in 2012, for a total of approximately 98 acres. The redevelopment plan includes restoring the front administration building and converting the remaining land to a golf course and maintenance structure(s). The redevelopment example presented includes the CBA (approximately 6 acres), which would be covered with clean imported fill soil to maintain an exposure buffer to the building slab, along with much of OU3. The overall size of the property would support development of a 9-hole course.

Imported clean fill soil would be used to shape the golf course. However, as it is unknown how much fill will be placed where, this risk evaluation was based on the current condition at the Site. Risk assessments for the excavation worker were completed previously for OU3 and for the CBA. The Unified Environmental Covenant (UEC) recorded for the property provides for an 'informed and trained' person to evaluate the need and use of personal protective equipment for soil disturbance associated with a specific construction plan (i.e., a Soil Management Plan). Once a specific construction plan has been prepared, a Soil Management Plan would be developed to provide specific health and safety protocols to mitigate chemical exposure to the construction worker based on the areas of the Site where activities will occur. Potential exposure in the CBA including to mercury vapors was also evaluated.

Two types of receptors were considered: recreational user (i.e., adolescent golfer and adult golfer) and maintenance worker (i.e., groundskeeper). Other Site workers would have lesser exposure than the groundskeeper; thus, there was no need to separately evaluate the lesser degree of exposure. It is assumed that these receptors are exposed via ingestion, inhalation and dermal contact to COPCs from the OU3 HHRA, which is inclusive of constituents present in the CBA portion of the uplands. The receptors could be exposed to surface soil at the Site. Specifically, the sample results used to estimate exposure for the redevelopment area include samples with a top depth of less than or equal to 1 ft bgs and bottom depth of less than or equal to 2 ft bgs. The sample results used for estimating exposure in the CBA evaluation are the same as that used in the HHRA for the CBA, namely all native soil samples with an end depth less than or equal to 2 ft bgs. The COPC screening process, exposure assessment, and chemical specific parameters are discussed in detail in the Golf Course Redevelopment Risk Evaluation Technical Memorandum which is available in the AR.

Two evaluations were presented: (1) the entire redevelopment area (the Site inclusive of the CBA), and (2) a separate evaluation for the CBA (for sake of completeness in the assessment). The redevelopment area risk was evaluated in two ways as a bounding exercise. The first assumed that the receptors are exposed to all the native surface soil at the Site. This exposure assumption is inherently conservative since much of the Site has been covered with clean backfill, meaning much of the native soil is now covered by clean backfill, but is presented to be consistent with the OU3 risk assessment. The second evaluation accounted for clean backfill placed at the Site as a result of past cleanup actions. (Note that additional clean backfill used to shape the golf course would result in lower exposure to Site contaminants and lower health risks than what was quantified.) Clean backfill (from the Removal Action of 1994-97) covers a significant portion of the Site. Approximately 29 of the 98 acres are covered with more than one foot of clean soil. Accordingly, a receptor with exposure across the entire Site would encounter native Site soil 70% of the time. The exposure assessment for the CBA is the same as that used for the OU2 HHRA.

The risk evaluations indicated that neither of the exposure units exceeded EPA acceptable risks thresholds (cancer risk of 1x10-4 and a non-cancer hazard index of 1) for the adolescent golfer, the adult golfer and the groundskeeper. Results of the risk assessment for use of the Site as a golf course support the conclusion that the Site is safe for this redevelopment consideration. However, the results of the full HHRA in the RI conclude that action should be taken to address existing risk at the Site for other receptors (namely excavation workers and hypothetical residents).

It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare and the environment from the risks associated with actual releases of hazardous substances to the environment.

Remedial Action Objectives

In accordance with the NCP, EPA developed **Remedial Action Objectives** (RAOs) to describe what the proposed cleanup is expected to accomplish to protect human health and the environment. The RAOs for OU2 are based on results of the HHRA. RAOs help focus the development and evaluation of remedial alternatives and form the basis for establishing **Preliminary Remediation Goals** (PRGs) in the Proposed Plan and the cleanup levels selected in the ROD. The RAOs are as follows:

- RAO1: Prevent human exposure by direct contact to the surficial and subsurface soil across the CBA to mercury through ingestion and dermal contact above levels protective of commercial, industrial, and recreational use of the area.
- RAO2: Treat to reduce the leachability potential of Hg^0 beads present within the aquifer matrix of the surficial aquifer and Hg^0 in soil by a 90% reduction of total mercury (dissolved phase in groundwater and total mercury in soil) as a performance standard.

  In order to consider a PRG for mercury in dissolved phase in groundwater, EPA is using the 95% Upper Confidence Limit (UCL) Exposure Point Concentration (EPC) in the RI (Table 7.6 of the RI) of 32 ug/L. A 90% reduction of this value results in a PRG of 3.2 ug/L for mercury (dissolved phase in groundwater). In order to consider a PRG for total mercury in soil, EPA is using the mixed soil (surface and subsurface) 95% UCL EPC in the RI (Table 7.27 of the RI) of 188 mg/kg. A 90% reduction of this value results in a PRG of 18.8 mg/kg for total mercury in soil.

Note: The FFS listed RAO3 to address potential Hg^0 emissions from the CBA. However, additional sampling for mercury vapor as reported in the FFS has indicated this is not an ongoing or potential future risk that needs to be addressed based on soil gas and ambient air sampling results.

Summary of Remedial Alternatives

Three alternatives were developed for consideration in addressing mercury contamination at OU2 for this early interim source control action in the FFS. Additional alternatives will be developed in a future Feasibility Study for the entirety of OU2, including Site-wide groundwater.

Table 2 provides the estimated time to construct and implement the remedy until RAOs are met, along with the estimated costs, separated into capital (construction), total annual operation and maintenance (O&M), and total present worth costs.

Table 2: Estimated Construction Time and Costs for the Remedial Alternatives

Remedial Alternative	Construction Time	Time until RAOs are Met	Capital Costs	30-Year O&M Costs	Total Present Worth
1: No Further Action	Site Visit: 1 week	Not Applicable	$15,000	$210,000	$225,000
2: In-situ Biological Treatment and Soil Dermal Cover	• Pilot Studies: 6-9 months • Site Preparation: 1 month • Injection Well Network: 2 months • Injection System Setup/ Testing: 1 month • Injection: 3 months • Soil Dermal Cover: 1.2 months • Total Time: 15.2 months	RAO1 met upon completion of dermal cover maintenance. RAO2 met over the 30-year period of Monitoring	$3,737,000	$2,166,000	$5,903,000
3: In-situ Chemical Sequestration (ICS) and Soil Dermal Cover	• Pilot Studies: 6-9 months • Site Preparation: 1 month • Injection Well Network: 2 months • Injection System Setup/ Testing: 1 month • Injection: 3 months • Soil Dermal Cover: 1.2 months • Total Time: 15.2	RAO1 met upon completion of dermal cover maintenance. RAO2 met after implementation of ICS and a two-year period of performance monitoring.	$4,502,000	$210,000	$4,712,000

Each alternative is described below:

Alternative 1 – No Action
This alternative consists of conducting no further cleanup. CERCLA and the NCP requires an evaluation of a no action alternative to provide a baseline for comparison with other remedial alternatives.

Alternative 2 – In-situ Biological Treatment and Soil Dermal Cover
This alternative involves in-situ application of a biological agent (or agent to induce biological activity) into the areas containing beads of Hg^0. This technology develops out of wastewater treatment applications and is recognized by the EPA as viable in that regard (i.e., for treatment of dissolved phase), but it would be innovative to apply to treatment of Hg^0 beads. This alternative would require further studies and field testing to verify the efficacy on Hg^0. This alternative also includes the use and improvement of the soil dermal cover ensuring a minimum of 2 feet (24 inches) in thickness across the CBA.

Bench-scale studies would be required to select the appropriate biological treatment along with field studies and a full treatability study before full implementation. The selected delivery method for biological agent will depend on the results of the treatability studies. However, EPA expects that biological agents would be delivered using an injection technology with injection wells installed to directly treat the mercury in the subsurface of the CBA. If this is the case, the subsurface obstructions and pilings beneath the CBA do not preclude the injection and distribution of the media. Injection points or possibly amendment volumes can be modified to maintain amendment loading targets. It is assumed that maintenance injection at some point into the future will be necessary to revitalize the applied microbial population

Remedial Alternative 2 maintains the soil dermal cover originally installed during the earlier removal action phase of the response and land use restrictions established under the existing Site ICs required under the terms of the removal Action Memorandum. The existing ICs include the industrial zoning and the Uniform Environmental Covenant with the state of Georgia. The soil dermal cover across the CBA along portions of the periphery is less than 2-ft thick. Under this alternative, additional clean fill soil will be used to ensure a minimum 2-ft thickness of the cover throughout the CBA. Alternative 2 includes 30 years of performance monitoring including groundwater monitoring until the Final ROD for OU2 is implemented.

Remedial Alternative 2 as described in the FFS included Monitored Natural Attenuation (MNA) and EPA's approval of the FFS clarified that this would be an evaluation of MNA for the entirety of OU2, not selecting MNA for this Interim Remedy. However, EPA has since requested that periodic groundwater monitoring be conducted that would include collection of MNA parameters. Therefore, MNA evaluation is no longer included in the alternatives for this Interim Remedy.

Alternative 3 – In-situ Chemical Sequestration (ICS) and Soil Dermal Cover. This alternative is an ICS approach designed to sequester Hg^0 (chemically alter the Hg^0 or passivate the Hg^0) in the

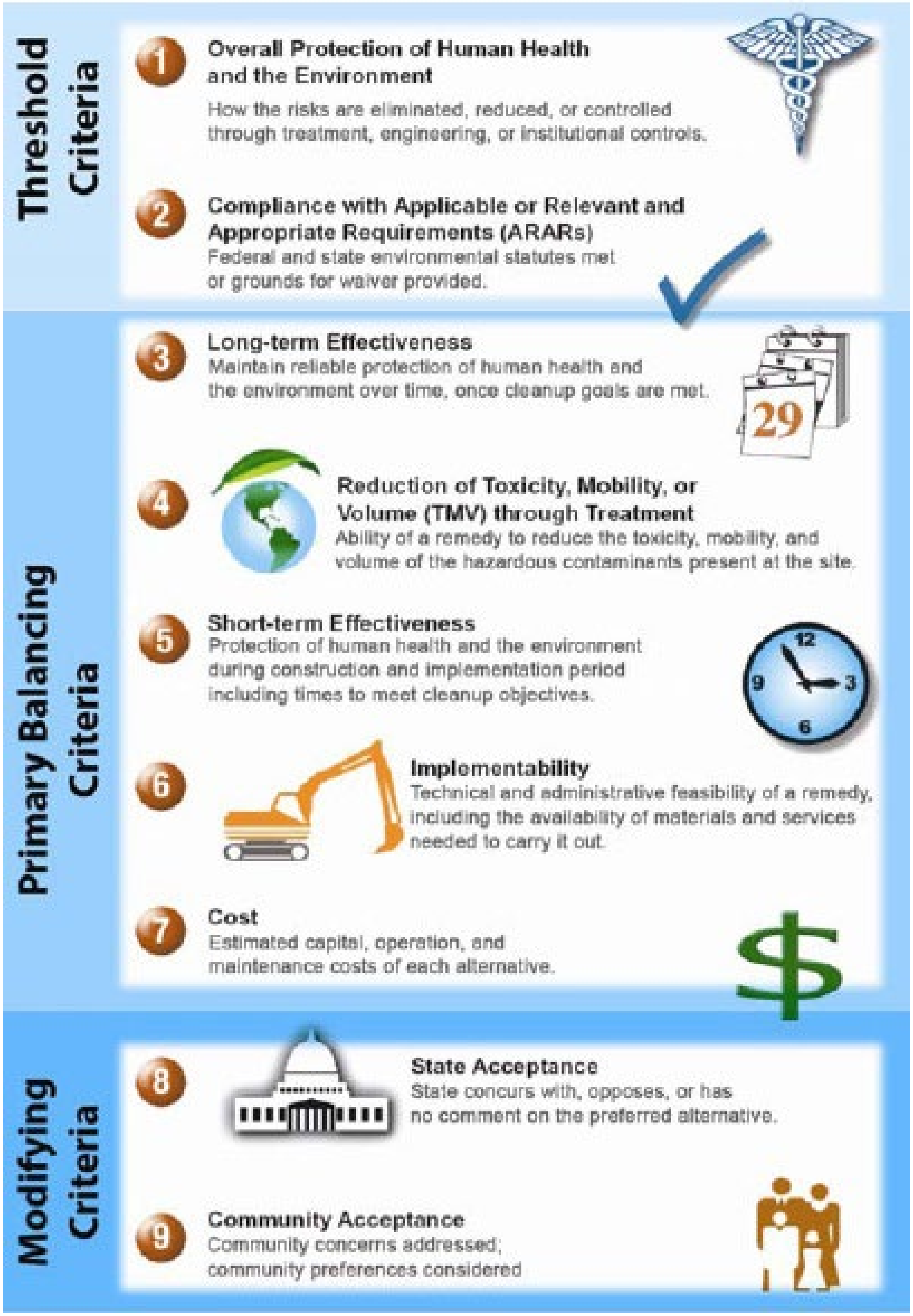
CBA soil (aquifer matrix) and mitigate the transfer of mercury to a dissolved-phase plume. The alternative combines other elements of existing Site controls including the ICs described in Alternative 2 and the soil dermal cover. Alternative 3 will require a bench-scale and full treatability study like Alternative 2, however the technology has been demonstrated and is better understood than biological amendments as described in Alternative 2. An advantage of ICS is the technology is implemented with conventional injection wells or direct injection technology as a liquid slurry into the aquifer matrix. The subsurface obstructions and pilings beneath the CBA do not preclude the injection and distribution of the media. Injection points or amendment volumes can be modified to maintain amendment loading targets. This alternative also includes the use and improvement of the soil dermal cover ensuring a minimum of two feet (24 inches) in thickness across the CBA.

Alternative 3 maintains existing the land use restrictions described in Alternative 2 and the use and improvement of the soil dermal cover the same as Alternative 2 and includes two years of performance monitoring and groundwater monitoring or until the Final ROD for OU2 is implemented.

Evaluation of Alternatives

The remedial alternatives were evaluated using the criteria listed in the NCP. General descriptions of the nine criteria are presented in Figure 6.

Figure 6: Criteria for Comparison of Alternatives



Protection of human health and the environment and compliance with **Applicable or Relevant and Appropriate Requirements** (ARARs) are threshold criteria that each alternative must meet to be eligible for selection, unless they are waived. A complete discussion of ARARs for all of the alternatives is presented in the FFS Report. Final ARARs will be listed in the Record of Decision.

The five balancing criteria (i.e., long-term effectiveness; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost) are used to weigh major tradeoffs in the benefits and limitations among alternatives. Modifying criteria include state acceptance and community acceptance.

Table 3 summarizes the comparison of the remedial alternatives for the Site. The alternatives were compared using the NCP criteria (see Figure 6). A detailed comparison of the Alternatives can be found in the FFS Report. The following is a summary of the comparisons that were made in the remedial alternative evaluations of the FFS Report for the Site.

Table 3 Summary of Comparative Analysis of Remedial Alternatives

Remedial Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume via Treatment	Short-term Effectiveness	Implementability	Total Present Worth
1: No Further Action	**No**	**No ARARs for no action**	⊕	⊕	⊕	●	$225,000
2: In-situ Biological Treatment and Soil Dermal Cover	**Yes**: for alternatives 2 and 3 Prevents direct contact because the Hg^0 condition is beneath concrete foundation slabs and the soil cover. Additionally, treatment of the Hg^0 further reduces the mercury vaporization potential.	**Yes**: for Alternatives 2 and 3	◑ Biological treatment may convert mercury to species that are retained in the biomass or are more easily removed from water by another technology, such as adsorption or precipitation. In situ treatment application of this technology is considered innovative and not yet proven.	◑ Unknown and requiring testing to verify efficacy	◔ It is assumed that maintenance injection at some point into the future will be necessary to revitalize the applied microbial population	◕ The technology would be implemented by direct injection into the soil and shallow aquifer through conventional means. It is able to perform this function in the presence of the dense array of subsurface pilings present beneath the CBA.	$5,903,000
3: In-Situ Chemical Sequestration and Soil Dermal Cover			◕ The ICS approach for Hg^0 at full-scale is novel compared to more traditional approaches, and data for the technology is generally limited to bench-scale or pilot-scale evaluations. The bench-scale work has reported effective conversion of Hg^0 that will be evaluated under Site-specific condition in bench-scale and maybe pilot scale studies to established design parameters.	◕ Yes The ICS approach is innovative. While the available data indicates it will be effective, Site specific testing will be necessary to verify full efficacy.	◕ It is assumed that the initial ICS injections will be sufficient.	◕ This technology is readily implemented through direct injection where the liquid reagent is able to effectively mix and disperse through the aquifer matrix, mineralizing the outer surface of the Hg^0 beads (as an insoluble mercuric sulfide mineral). It is able to perform this function in the presence of the dense array of subsurface pilings present beneath the CBA. It is highly unlikely the mineral form will be reversed in the current/future geochemical environment. Periodic groundwater monitoring is	$4,712,000

Remedial Alternative	Overall Protection of Human Health and Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume via Treatment	Short-term Effectiveness	Implementability	Total Present Worth
						already planned to confirm that this will be the case and the final remedy for OU2 will take the results of the groundwater monitoring into consideration.	

Notes: ⊕ ◔ ◑ ◕ ●
Not acceptable ⟶ More acceptable

Note: information in this table has been updated based on the approval of the FFS

Criterion 1: Overall Protection of Human Health and the Environment

Remedial Alternative 1: NFA - The current state of the CBA area controls exposure. As summarized in the FFS Report, the dermal soil cover effectively protects human health (and the environment), and the IC in place adequately addresses all modes of potential exposure which might otherwise result in unacceptable health risks. The IC precludes residential land use and groundwater extraction and requires that any work on the Site where CBA surface or subsurface soils are to be disturbed (e.g., excavation, construction, utility installation, or maintenance) must be performed by informed and properly trained personnel using appropriate personal protective equipment, and lastly, any new building construction must involve a vapor intrusion assessment. As noted in the HHRA, the results indicated a cancer risk for the hypothetical resident and the excavation worker and the non-cancer hazard index exceeded 1 for the excavation worker. NFA would not be protective of these receptors.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - The in-situ application of biological agents into the shallow aquifer is intended to reduce the leachability potential of Hg^0 beads present in the subsurface, and in doing so provide for protection of human health and the environment. The dermal soil cover effectively protects human health and will be enhanced by additional soil placement along the fringe. The soil cover will be maintained at 2 foot (24 inch) minimum thickness. The soil cover will be maintained at 2 foot (24 inch) minimum thickness. The existing ICs adequately addresses all modes of potential exposure which might otherwise result in unacceptable health risks. The IC, which is already in place, is a component of all remedial alternatives and provides stated measures for protection against contaminant exposure. Alternative 2 includes continued monitoring and verification of plume stability, thus providing direct evidence of protection of human health and the environment. The biological treatment protects human health and the environment by treating the mercury in multiple forms. Lastly, any new building construction must involve a vapor intrusion assessment, per the existing Uniform Environmental Covenant.

Remedial Alternative 3: ICS and Soil Dermal Cover - Remedial Alternative 3 is protective of human health and the environment. The dermal soil cover effectively protects human health and will be enhanced by additional soil placement along the fringe. The soil cover will be maintained at 2 foot (24 inch) minimum thickness. The IC adequately addresses all modes of potential exposure which might otherwise result in unacceptable health risks. The IC, which is already in place, is a component of all remedial alternatives and provides stated measures for protection against contaminant exposure. Two years of evaluation provides for continued monitoring and verification of plume stability, thus providing direct evidence of protection of human health and the environment. The ICS treatment protects human health and the environment by treating the mercury in multiple forms. Lastly, any new building construction must involve a vapor intrusion assessment, per the existing Uniform Environmental Covenant.

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Criterion 2: Compliance with ARARs

Remedial Alternative 1: NFA – Remedial Alternative 1 complies with ARARs because no remedial activity is implemented, and there are no chemical-specific ARARs identified for this interim early action.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - Remedial Alternative 2 complies with ARARs regarding aquatic resources and coastal zone areas, threatened and endangered species, land-disturbing activities, waste characterization, treatment, transportation, and disposal, temporary storage of wastes, treatment and disposal of PCBs, underground injection wells, and discharges of wastewaters.

Remedial Alternative 3: ICS and Soil Dermal Cover) – Remedial Alternative 3 complies with ARARs the same as Remedial Alternative 2.

Criterion 3: Long-Term Effectiveness and Permanence

Remedial Alternative 1: NFA – The NFA alternative is ineffective in the long-term as no maintenance to the CBA soil dermal cover is required, potential changes in subsurface condition will not be monitored, and the alternative does not reduce the Hg^0 presence through treatment.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - The long-term effectiveness of a biological-based treatment is uncertain as the technology has not been used in the context of Hg^0 treatment in the subsurface Continued maintenance of the CBA soil dermal cover with the added soil on the fringes should provide even more protection than current conditions.

Remedial Alternative 3: ICS and Soil Dermal Cover – ICS was selected for development as a remedial alternative partially for its long-term effectiveness and its implementability. The ICS end product, mercuric sulfide, is stable and insoluble under the present-day and expected future CBA geochemical setting and that of the background groundwater condition based on thermodynamic considerations as discussed in the FFS Report. Factors that could potentially enhance mercuric sulfide solubility, high dissolved ion concentrations from the historical release of brine, and the solubilized organic matter due to the former CBP condition, are diminishing as evaluated in the OU2 RI Report. These conditions are expected to continue to decline as background groundwater replaces the current CBA condition and as the CO_2 remaining in the system continues to buffer the groundwater in the area.

Criterion 4: Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Remedial Alternative 1: NFA – The NFA alternative does not achieve a reduction in Hg^0 toxicity, mobility, or volume.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - Alternative 2 is intended to achieve a reduction in Hg^0 toxicity, mobility, or volume through active treatment involving biological technologies. Biological treatment has been used in mercury-containing wastewater applications but is considered innovative in the context of Hg^0 in soil. Additional proof of process would be needed involving extensive literature review, bench scale testing, and field testing and demonstration.

Remedial Alternative 3: ICS and Soil Dermal Cover – The objective of the ICS alternative is to achieve a reduction in Hg^0 and other forms of mercury compounds in the subsurface toxicity, mobility, or volume through in situ treatment resulting in conversion and encapsulation of Hg^0. While ICS is considered an "innovative" remedy, it has been demonstrated in other locations and is supported by known geochemical processes.

Criterion 5: Short-term Effectiveness

Remedial Alternative 1: NFA – The NFA alternative is considered effective in the short-term for RAO1 as the dermal cover prevents direct contact with subsurface Hg^0, and vapor emissions are within acceptable risk levels. The NFA alternative, however, is ineffective concerning RAO2 as it does not reduce the Hg^0 presence through treatment.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - The efficacy of biological treatment for an Hg^0 condition is innovative and would require testing to evaluate the effectiveness of this approach in addressing RAO2. The present risk is within an acceptable range for the Site land use under current IC restrictions for direct contact or vapor intrusion. Addition of clean soil along the CBA soil cover periphery will enhance the effectiveness of this element of the remedy (i.e., dermal contact protection). Performance monitoring would determine the short-term effectiveness. Due to the expected long-term action for biological treatment, the time to meet RAOs is estimated to be 30 years after the injection phase of 15.2 months. Minimal staging will be needed to implement the injection technology and there will be minimal impacts to the community during the injection phase or the monitoring phase. As this is an injection technology impacts to commercial Site workers are also expected to be minimal with low chances of accidents or exposure to Site contaminants.

Remedial Alternative 3: ICS and Soil Dermal Cover – The efficacy of ICS treatment for an Hg^0 condition is also somewhat innovative and would require treatability studies as part of this approach in addressing RAO2. The present risk is within an acceptable range for the Site land use under current IC restrictions for direct contact or vapor intrusion. Addition of clean soil along the CBA soil cover periphery will enhance the effectiveness of this element of the remedy (i.e., dermal contact protection). The chemical reaction rate between the ICS amendment(s) and Hg^0 is expected to occur soon after application. Although the sequestration of subsurface Hg^0 is not expected to occur uniformly throughout the CBA at the time of implementation, it will likely occur on the scale of months following as dispersion and diffusion processes serve to further distribute the applied media. Due to the relative simplicity of the direct injections, multiple injections can be performed in targeted areas as needed to achieve adequate distribution of the ICS chemistry (based on performance monitoring following the initial application). Due to the expected shorter-term action for ICS treatment, the time to meet RAOs is estimated to be 2 years after the injection phase of 15.2 months. Minimal staging will be needed to implement the injection technology and there will be minimal impacts to the community during the injection phase or the monitoring phase. As this is an injection technology impacts to commercial Site workers are also expected to be minimal with low chances of accidents or exposure to Site contaminants. Appropriate precautions will be taken into consideration for polysulfides to minimize any commercial Site worker contact risk.

Criterion 6: Implementability

Remedial Alternative 1: NFA – There are no actions to implement.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover - In situ treatment is readily implemented by direct injection of liquid biological agents into the subsurface zones characterized with Hg^0 beads. Biological treatment of mercury involves conversion of soluble mercury into a less soluble Hg^0 form or into insoluble mercuric sulfide. High concentrations of contaminants such as mercury or chlorine can inhibit microbial activity. Nutrients, pH, and temperature must be maintained at levels that optimize biological activity and growth. Pretreatment with pH amendment agents such as sodium hydroxide or phosphoric acid is essential to maintain an optimal pH range. Nutrient additives such as sucrose, yeast, and salt may be required to support the growth of microbes. Bench-scale studies would be required to select the appropriate biological treatment along with field studies and a full treatability study before full implementation. The selected delivery method for biological agent will depend on the results of the treatability studies but is likely to be injection similar to Alternative 3.

The soil dermal cover presently exists and has been in place since 1997 and will be enhanced for uniform thickness of at least 2 feet or 24 inches at the fringes. The soil dermal cover can be maintained with conventional earthwork equipment; no unique cover materials are necessary.

Remedial Alternative 3: ICS and Soil Dermal Cover – There are two tasks to achieve ICS implementability. The first task is the sequestration chemistry evaluation of the chemical approaches to achieve sequestration of Hg^0. The second task is the delivery of the selected sequestration chemistry to the subsurface Hg^0. The development of the sequestration chemistry is summarized in in the FFS Report, and up to four different chemical approaches will be evaluated with bench-scale evaluation. The sequestration chemistry evaluation will focus on the efficiency of each chemistry to convert and stabilize Hg^0 under Site-specific conditions including potential interfering factors. Thermodynamically, all options proposed are capable of achieving Hg^0 sequestration. The second task involving the delivery of the sequestration chemistry to the subsurface Hg^0 is implementable through conventional drilling technology (i.e., direct push injections). Direct push drilling has successfully penetrated the full depth of the CBA where Hg^0 is known to reside.

The dispersal of the sequestration chemistry to Hg^0 is expected to be feasible and has been previously demonstrated at the Site for delivery of CO_2 in situ. In vertical profile, Hg^0 droplets are not uniformly distributed across the depth of the Satilla but are found as droplets occurring in the aquifer sands at the interface of well-sorted sand lenses perched atop a layer of low permeability clay or silt. The occurrence of the Hg^0 droplets within the aquifer sands, and therefore within layers of higher permeability, is anticipated to benefit the distribution and contact of chemical amendments with the entrained Hg^0 droplets, i.e., the applied amendment will follow the path of lesser resistance, higher permeability. The soil dermal cover components of Alternative 3 has the same implementability considerations of Alternative 2.

Criterion 7: Cost

Remedial Alternative 1: NFA –
- Capital Cost: $15,000
- 30-yr O&M Cost: $210,000

The estimated cost for Remedial Alternative 1 is $225,000 and is based on annual inspection of adherence to the **Uniform Environmental Covenant** (UEC) (e.g., land use restriction) for a 30-year period. Details of the estimated cost are provided in the FFS Report.

Remedial Alternative 2: In Situ Biological Treatment and Soil Dermal Cover –
- Capital Cost: $3,737,000
- 30-yr O&M Cost: $2,166,000

The estimated cost for Remedial Alternative 2 is $5,903,000 and is based on study and implementation of biological treatment, annual inspection of the UEC (e.g., land use restriction), annual groundwater monitoring, and enhancement and maintenance of the CBA soil dermal cover for a 30-year period. The cost includes an assumed maintenance injection at some point into the future to revitalize the applied microbial population. The cost framework and basis are provided in the FFS Report.

Remedial Alternative 3: ICS and Soil Dermal Cover –
- Capital Cost: $4,502,000
- 30-yr O&M Cost: $210,000

The estimated cost for Remedial Alternative 3 is $4,712,000 comprised of ICS pilot study work and completion of the ICS treatment for the two treatment zones with a two-year performance monitoring period, as well as the other obligations, inspection of adherence to the UEC (e.g., land use restriction), and enhancement and long-term maintenance of the CBA soil dermal cover as outlined for Remedial Alternative 2. The cost framework and basis for ICS are provided in the FFS Report.

Criteria 8 and 9: State Acceptance and Community Acceptance

State acceptance will be evaluated upon receipt of all Regulatory Agency comments on the proposed plan. However, GEPD has been fully engaged in the RI and FFS and has supported the efforts. EPA has held multiple sessions with the community and community groups and representatives to brief on the results of the RI and the FFS process and findings. Community acceptance will be evaluated upon receipt of all community comments on the Proposed Plan.

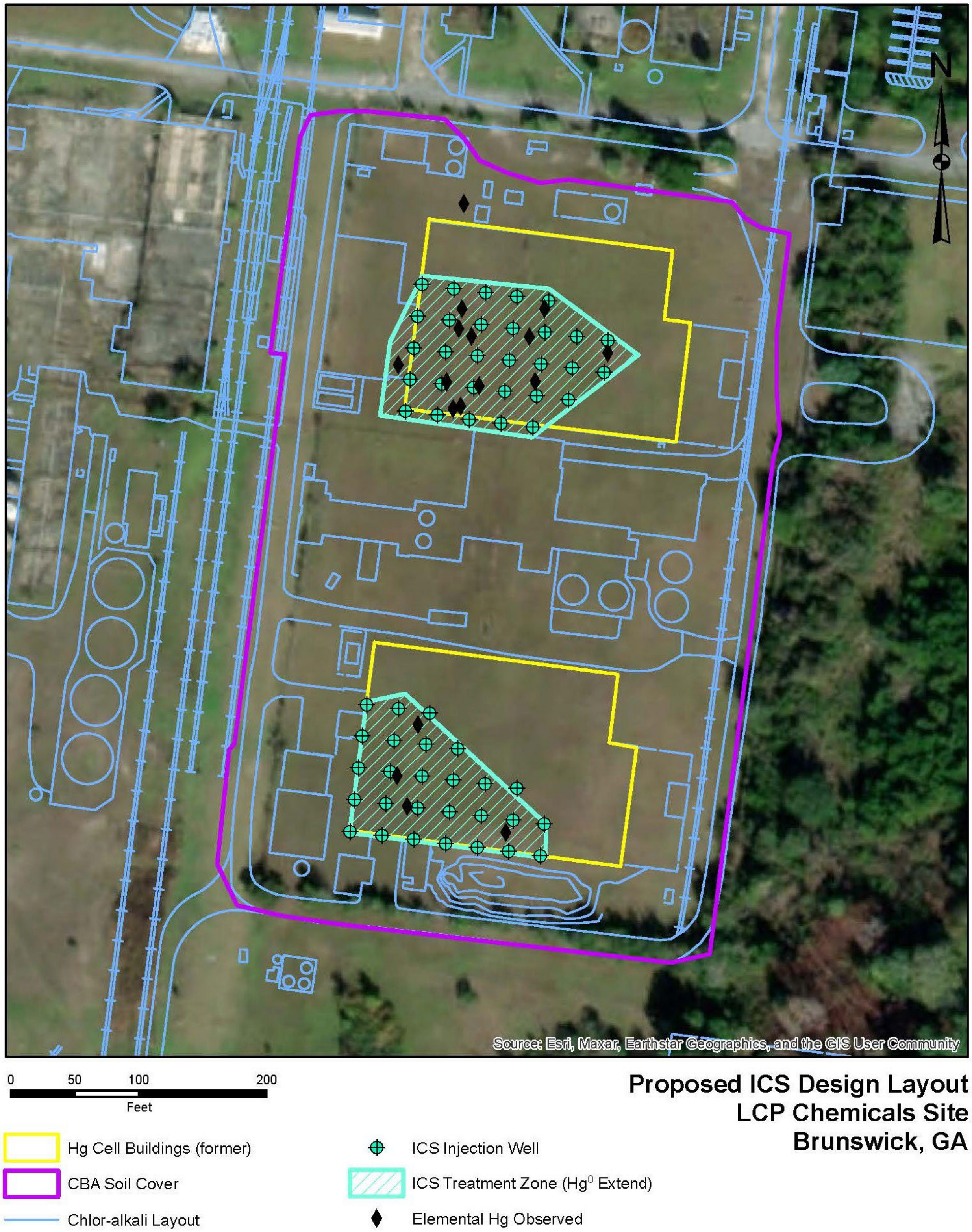
Preferred Alternative

The EPA's Preferred Alternative for the Site is Alternative 3 – In-situ Chemical Sequestration (a form of chemical treatment) and Improvement and Maintenance of the Existing Soil Dermal Cover, and Institutional Controls (in the form of the existing Environmental Covenant and Zoning restrictions). This alternative consists of the improvement and maintenance of the existing soil dermal cover to a minimum of 2 feet (24 inches) over all portions of contaminated soil to minimize water infiltration (by being graded to promote runoff) and to limit inadvertent human intrusion activities. ICS, using polysulfide and/or other amendments as appropriate, would be applied to the subsurface prior to finalizing the soil cover to convert Hg^0 to a form of mercuric sulfide and to minimize the dissolution of mercury. Performance monitoring would be implemented following the subsurface amendments and cover maintenance. See the proposed ICS design layout shown on Figure 7. While one location of detected elemental mercury is to the north of the outline of former Cell Building One in the proposed design layout, it will be determined if that location will be included in the treatment area during the actual design or if it will be addressed in another manner.

Based on information available at this time, EPA believes Alternative 3 would be protective of human health and the environment and would comply with state and federal ARARs. As shown on Table 3, Alternative 3 provides the best balance of tradeoffs among the other alternatives with respect to the nine NCP criteria for the evaluation and selection of the interim remedy to address mercury at the Site. The EPA expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA 121(b): 1) be protective of human health and the environment; 2) comply with ARARs (or justify a waiver); 3) be cost-effective; and 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

As noted previously, the Preferred Alternative may be changed in response to public comment or new information.

Figure 7: Proposed Alternative 3 ICS Design Layout [Source: Figure 6-1 in FFS Report]



COMMUNITY PARTICIPATION

The EPA encourages members of the public to review and comment on this Proposed Plan. To gain a more thorough understanding of the Site and the CERCLA activities that have been conducted, members of the public may visit the information repository or the website to review the AR file and other Site-related documents, attend public meetings, and sign-up for the mailing list to receive regular project information.

There are two ways for you to provide your comments on this Proposed Plan:

1. **Public Comment Period: During the public comment period from July 5, 2024 to August 5, 2024 you may use the comment form included with this Proposed Plan to send written comments to Robert Pope, Remedial Project Manager, U.S. Environmental Protection Agency, 61 Forsyth Street SW, Atlanta, GA, 30303, or by email to pope.robert@epa.gov.**

2. **Public Meeting: You may provide written or oral comments during the public meeting on July 18, 2024, beginning at 5:30 PM, which will be held at Zion Rock Missionary Baptist Church, 3200 Gordon St, Brunswick, GA 31520. A stenographer will be at the meeting to record all public comments.**

After the public comment period is over, EPA will review and consider the comments before making a final decision on the remedial alternative to be used at the Site. Responses to comments will be documented in the Responsiveness Summary of the ROD. All Site-related documents will be available for review in the information repositories and AR file as listed below.

INFORMATION REPOSITORIES

The public information repositories for the Site are at the following locations:

Online LCP Chemicals Available Documents **https://www.epa.gov/superfund/lcp-chemicals-georgia**

Three Rivers Regional Library System (formerly Brunswick-Glynn County Library System)
208 Gloucester Street
Brunswick, Georgia 31520

CONTACT INFORMATION

Robert Pope
Remedial Project Manager
U.S. Environmental Protection Agency
61 Forsyth Street SW
Atlanta, GA 30303
pope.robert@epa.gov

USE THIS SPACE TO WRITE YOUR COMMENTS

Your input on the Proposed Plan for the LCP Chemicals Georgia Superfund Site in Brunswick, Glynn County, Georgia, is important to the EPA. Comments provided by the public help EPA select the final remedial alternative for sites undergoing cleanup. EPA will respond to all comments received by the deadline in writing in the Responsiveness Summary section of the Record of Decision.

You may use the space below to write comments. Attach additional pages if you need additional space for your comments. Comments must be received by August 5, 2024. Send comments to Robert Pope, Remedial Project Manager, U.S. Environmental Protection Agency, 61 Forsyth Street SW, Atlanta, GA, 30303, or by email to pope.robert@epa.gov.

If you would like to be on the mailing list to receive information about the environmental restoration activities at LCP Chemicals Georgia Superfund Site, please provide you name and address below.

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Name ______________________________
Address ____________________________
City ____________ **State** _____ **Zip** ______

☐ **Yes, add me to the mailing list**

GLOSSARY

Administrative Record: A collection of all documents considered in selecting a remedy for a CERCLA Site.

Anode: An electrode through which current enters.

Applicable or Relevant and Appropriate Requirements (ARARs): Federal, state, and local environmental laws, regulations, and standards determined to be legally applicable or relevant and appropriate to removal or remedial actions at a CERCLA Site. The NCP requires compliance with all state or federal ARARs at a Superfund Site unless they are waived.

Benzene, toluene, ethylbenzene, and xylenes (BTEX): Volatile organic compounds that are found in petroleum and petroleum products, such as gasoline, coal, and wood tars. BTEX compounds are clear, colorless, highly flammable liquids at room temperature.

Cancer risk: The probability that an individual will develop cancer from direct exposure to chemicals classified as human carcinogens.

Cathode: An electrode through which current leaves.

Chlor-alkali: Refers to a production method for producing chlorine and sodium hydroxide. In a normal production cycle a few hundred pounds of mercury per year are emitted, which accumulate in the environment. Additionally, the chlorine and sodium hydroxide produced via the mercury-cell chlor-alkali process are themselves contaminated with trace amounts of mercury. Other chlor-alkali cell types not present at the Site include the membrane and diaphragm types.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): The federal law (also referred to as the "Superfund" law) that established a program to identify hazardous waste sites and procedures for cleaning up these sites to protect human health and the environment, and to evaluate damages to natural resources.

Chemical of Concern (COC): A chemical that has been released to the environment at concentrations greater than those considered safe for humans and/or ecological receptors.

Ebenezer Formation: Sedimentary deposits (rock layers) underlying the Satilla Formation.

Ecological Receptors: Any living organisms other than humans, the habitat which supports such organisms, or natural resources which could be adversely affected by releases of environmental contaminants.

Exposure pathway: The means by which humans and ecological receptors come into contact with (or get exposed to) a chemical or substance (e.g., inhalation of contaminated dust or drinking contaminated groundwater).

Exposure scenarios: A set of facts, assumptions, and inferences about how exposure takes place that aids the risk assessor in evaluating, estimating, or quantifying exposures.

Exposure Point Concentration (EPC): The representative concentration of a given potential COC with which the receptor is potentially in contact. A representative potential COC-specific EPC value is incorporated into the exposure assessment equations from which potential human exposures are calculated. The EPC is intended to be a conservative estimate of the average concentration at a given point in time. EPCs can be calculated for ecological receptors, however, ecological EPCs are not pertinent to this proposed action.

Exposure Unit: The area in which a receptor is expected to be present or exposed.

Feasibility Study (FS): The second of two major studies that must be completed before a decision can be made about how to clean up a Site. (An RI is the first step; it identifies the nature and extent of contamination at the Site and the associated risk.) The FS uses the information developed in the RI to establish remedial action objectives and goals and to screen and evaluate possible remedial technologies that are combined into proposed remedial alternatives for cleaning up a Site.

Groundwater: Underground water that fills spaces between particles of soil, sand, and gravel or openings in rocks to the point of saturation. Groundwater can be used as a source of drinking water, for industrial uses, or for agricultural irrigation.

Hazard index (HI): For human health, the hazard index is a calculated value used to represent a potential non-cancer health hazard for more than one chemical or exposure pathway. The hazard index is the sum of the hazard quotients. A hazard index value of 1 or less for any particular target organ is considered an acceptable exposure level. If the hazard index exceeds 1, exposure to contaminants may pose non-cancer health hazards. Non-cancer health hazards are contaminant-dependent, but may include kidney disease, headaches, dizziness, and anemia.

Hazard quotient (HQ): The ratio of a contaminant concentration divided by the safe exposure level.

Human health risk assessment (HHRA): A qualitative and quantitative evaluation performed in an effort to define the risk posed to human health by the presence or potential presence of specific contaminants.

Light detection and ranging (LiDAR): A detection system which works on the principle of radar but uses light from a laser.

Maximum Contaminant Level (MCL): The maximum level allowed of a contaminant in water which is delivered to any user of a public water system.

Mercury Cell Process: In the mercury cell process, sodium forms a "mixture" of two metals with mercury at the cathode. The "mixture" reacts with water in a separate reactor where hydrogen gas and caustic soda solution are produced. Chlorine gas, produced at the anode, contains a small amount of oxygen and can generally be used without further purification.

Monitored Natural Attenuation (MNA): An in-situ remediation technology that relies on naturally occurring and demonstrable processes in soil and groundwater which reduce the mass and concentration of the contaminants.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The NCP is the set of regulations that establishes the framework for responses to oil spills and hazardous substances.

Operable Units (OUs): Separate areas/activities undertaken as part of a Superfund Site cleanup. Often a Superfund Site is divided by area or into phases to better address different pathways and areas of contamination.

pH: A measure of how acidic or basic water is.

Polychlorinated biphenyl (PCB) Aroclor: A compound formerly used in transformers and other electrical equipment. An "Aroclor" is a discontinued registered trademark for a series of PCB mixtures.

Polynuclear aromatic hydrocarbons (PAHs): Chemicals that primarily are associated with oil, coal, and tar deposits or are produced as byproducts of fuel combustion.

Potentially responsible party: Person or entity responsible for CERCLA response costs incurred.

Preferred remedial alternative: The remedial alternative selected by the EPA, in conjunction with the other regulatory agencies, based on the evaluation of remedial alternatives presented in the FS.

Preliminary remediation goal: A concentration established preliminarily for a given constituents of concern as a remedial benchmark for protectiveness of human health and the environment under a specific scenario of land use (e.g., commercial, industrial, or residential).

Proposed Plan: Superfund public participation document that summarizes the preferred cleanup strategy for a Superfund Site.

Receptors: People, plants or wildlife that may be exposed to contaminants released to the environment.

Record of Decision (ROD): The document that sets forth the basis for EPA's decision to select a particular remedial alternative for implementation at a CERCLA Site. The ROD is based on information from the RI, FS, and other reports, and on public comments and community concerns.

Reference dose/Reference concentration: An estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. Generally used in EPA's noncancer health assessments.

Remedy: An environmental cleanup conducted based on a ROD that involves actions to contain, collect, or treat hazardous wastes (or a combination of all three) to protect human health and the environment.

Remedial Action Objectives (RAOs): Statements that describe the goals of a cleanup in terms of the protection of one or more receptors (e.g., people, plants, or wildlife) from one or more chemicals in a specific medium (such as soil, groundwater, or air) at a Site.

Remedial Investigation (RI): One of two major studies that must be completed before a decision can be made about how to clean up a site. The RI is conducted to evaluate the nature and extent of contamination at the site and the associated risk. (The FS is a second study that is only conducted when the RI recommends development of cleanup options for a site.)

Responsiveness Summary: A summary of oral and written comments received by EPA during a comment period on key EPA documents, and EPA's responses to those comments. The responsiveness summary is a key part of the ROD, highlighting community concerns for EPA decision-makers.

Risk management range: The risk management range as derived from the NCP is used for making risk management decisions. The default range used by EPA is considered to represent an excess lifetime cancer risk to an individual between and 1 in 1,000,000 (1x10-6) and 1 in 10,000 (1x10-4).

Satilla Formation: The uppermost portion of the sedimentary deposits underlying the Site.

Site Specific Remedial Goals (SSRGs): Calculated for each potential COC that is determined to be a COC. Consistent with EPA guidance, the SSRGs are calculated based on a progression of hazard indices and cancer risks (i.e., HIs of 0.1, 1.0, and 3.0, and a theoretical upper-bound cancer risk of 1E 10-6, 1 E10-5, and 1 E10-4) for individual chemicals. These are referenced as Remedial Goal Options (RGOs) in the RI and the FFS.

Sludges: A mixture of liquids and solids, usually produced as a byproduct of a manufacturing process.

Smear zone: The area where free product occurred in the soil and was then smeared across the soil when the water table fluctuated between historic high and low water table elevations. This zone may contribute to groundwater contamination when the water table intersects it.

Superfund: The common name for the program operated under the legislative authority of CERCLA, the federal law that governs cleanup of abandoned hazardous waste sites.

Target Analyte List (TAL): List of inorganic compounds/elements designated for analysis as contained in the version of the EPA Contract Laboratory Program Statement of Work for Inorganics Analysis, Multi-Media, Multi-Concentration in effect as of the date on which the laboratory is performing the analysis.

Vapor Intrusion Screening Levels (VISLs): VISLs are screening level concentrations for groundwater, soil gas (target sub-slab and near-source), and indoor air. The EPA VISL calculator identifies chemicals that are considered to be sufficiently volatile and toxic to warrant an investigation of the vapor gas intrusion pathway when they are present as subsurface contaminants.

Volatile organic compounds (VOCs): Organic chemical compounds that evaporate easily at room temperature.