1.0 INTRODUCTION

This Remedial Investigation (RI) Report is being submitted on behalf of the United States Army Corps of Engineers (USACE) for the former Camp Hero (the site) located in Montauk, New York. This RI was completed under the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS) for Hazardous, Toxic, and Radioactive Waste (HTRW), Project Number C02NY002403. Work conducted under the DERP FUDS program is compliant with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. This RI Report was prepared by the AECOM–Tidewater Joint Venture (JV), in coordination with the USACE New England and New York Districts, as well as the USACE Environmental and Munitions Center of Expertise (EMCX). This group of professionals is referred to within this report as the project delivery team (PDT). The following sections outline the purpose and scope of this report, provide site background and history, summarize the previous investigation and the available RI dataset, and present the organization of this RI Report.

1.1 Primary Objectives and Scope Summary

The primary objectives of this RI Report are to identify and summarize the nature and extent of potential releases and impacts in site media from former military operations, and to subsequently quantify whether unacceptable risks are posed to human health or ecological receptors associated with exposure to constituents from these historical operations.

The RI technical approach consisted of three phases of field investigation: Phase I, Phase II, and Phase III. The information included in this report represents data collected from all three phases conducted between May 2016 and June 2017. Prior to the Phase I investigation, a historical records review was conducted which identified 47 Areas of Concern (AOCs) at Camp Hero. The AOCs were investigated during the Phase I and II field efforts at Camp Hero. Prior to completing Phase III, a preliminary screening evaluation (PSE) was completed using the Phase I and II RI dataset to determine which AOCs required further assessment during the Phase III investigation. AOCs warranting further assessment were grouped into 18 decision units (DUs) and eight stream exposure areas (SEAs), as presented in the Phase III RI Sampling and Analysis Plan (SAP; AECOM-Tidewater JV 2017).

The objectives of each phase of investigation are described below in Section 1.2.4. Specific datasets included in this RI Report are described in Section 2.0. The information, data, and interpretations collected as part of this RI phase are the basis for the human health risk assessment (HHRA) and ecological risk assessment (ERA), which are also included as **Appendix M** and **Appendix N**, respectively. The objectives of the HHRA and ERA are to evaluate whether soil, sediment, surface water, and groundwater concentrations of site-related chemicals pose unacceptable risks to human health or the environment. The field investigations described in this RI Report were conducted in accordance with the approved RI Work Plan (AECOM-Tidewater JV 2016), Phase II RI Work Plan Addendum (AECOM-Tidewater JV 2017a), and Phase III RI SAP (AECOM-Tidewater JV 2017b).

1.2 Site Background

1.2.1 Site Description

Camp Hero State Park is located on the eastern tip of the south fork of Long Island, New York, approximately 5 miles east of the village of Montauk (**Figure 1-1**). The park consists of 469 acres and is bound by Montauk Highway (Route 27) to the north, the Atlantic Ocean to the south, Montauk Point State Park to the east, and an undeveloped sanctuary area to the west. The landscape includes wooded areas, freshwater wetlands, and seaside bluffs (**Figure 1-2**).

1.2.2 Site History

The former Camp Hero was established in early 1942 as a Coastal Defense Installation to defend the approaches to New York and was named in honor of Major General Andrew Hero. Three self-sufficient batteries (Battery 112, 113, and 216) and supporting facilities were constructed which included barracks, mess halls, hospital facilities, a motor repair shop (current Motor Pool building), a recreation facility, sentry boxes, and water supply and sewage facilities. A total of 600 enlisted men and 37 officers were stationed at Camp Hero (USACE 2000a).

Camp Hero was a sub-installation of the 11th Coast Artillery Regiment (Harbor Defense) located at Fort H.G. Wright, Fishers Island, Block Island Sound, New York. Fort H.G. Wright was under the control of the Eastern Defense Command. Elements from the 11th Coast Artillery Regiment, along with elements from the 242nd Connecticut National Guard Coast Artillery Regiment (Harbor Defense), augmented the 11th Coast Artillery Regiment at Fort H.G. Wright (USACE 2000a).

Battery 216 contained two 6-inch shielded guns, a mechanical power room, and powder room for storage of ammunition and powder charges. Battery 113 consisted of two 16-inch casemated guns and battle allowances of ammunition and powder charges were stored within the battery. Battle allowances of ammunition and powder charges for the Camp Hero battery guns were stored within the individual batteries at the site. War reserve allowances of ammunition for the batteries were also required. However, this ammunition was stored outside of Camp Hero installation boundaries at an unknown central depot location under the control of the Chief of Ordnance. Batteries 112 and 113 had a battle allowance of 200 16-inch, 2,240-pound (lb) projectiles and a war reserve allowance of 300 16-inch, 2,240-lb projectiles. Battery 216 had a battle allowance of 200 6-inch, 90-lb HE (high explosive) rounds and 300 6-inch, 105-lb AP (armor piercing) rounds, and a war reserve allowance of 300 6-inch, 90-lb HE rounds and 400 6-inch, 105-lb AP rounds (USACE 2000a).

Additionally, 37-millimeter (mm) weapons and 0.50-caliber antiaircraft weapon platoons were assigned to protect Camp Hero from air attack. Camp Hero's weaponry was periodically fired to practice over water, but was never fired as an act of hostility. It is presumed that the antiaircraft weapon ammunition for Camp Hero and nearby facilities was also stored within the battery ammunition storage facilities of Camp Hero, as no other historical or physical evidence is present to display a separate storage facility for these items. This was assumed to be possible due to the storage capacity of 400 rounds of ammunition in Batteries 112 and 113, and a battle allowance requirement of only 200 rounds of ammunition (USACE 2000a).

Camp Hero was placed on inactive status on 31 July 1947 and ultimately declared surplus by the Department of the Army on 31 December 1949. In 1949, approximately 97 acres of the former Camp Hero was transferred to the Department of the Air Force for an aircraft control and warning station. On 24 January 1951, the former Camp Hero was withdrawn from surplus and designated for use as a firing range and field exercise area for an antiaircraft artillery unit from Fort Totten, New York. Arrangements were made for an Army cadre at the site, and 90 mm and quad 0.50-caliber antiaircraft artillery began firing exercises from firing positions established in the southern bluff overlooking the Atlantic Ocean near Bunker 216. Tow target planes and radio controlled aircraft were used to gauge firing accuracy. Towed barges were also later used. Due to limited facilities for the training units, the units bivouacked at Camp Hero. Ammunition for training exercises, when required, was stored in the internal bunkers of the now unused Battery 216 (USACE 2000a).

In 1952, the Air Force property was renamed the Montauk Air Force Station and occupied by the Aircraft Control and Warning Squadron (ACWS). The facility was active until October 1958 when the ACWS was re-designated as the Radar Squadron with a new mission to provide surveillance data of air traffic in the area. To accomplish this mission, an advanced Specific Frequency Diversity Search Radar was built in late 1960 (AN/FPS-35 Radar Tower and Antenna).

In 1974, when some of the on-site military uses were still active, portions of the property were transferred from the Department of Defense (DoD) to the State of New York. With the departure of the last military personnel from the site in 1980, the DoD declared the remainder of the property to be surplus federal land. Over the next few years, the property was divided and deeded to the State of New York and Town of East Hampton. The ACWS facility was permanently closed in 1982 and the final land transfer to the state occurred in 1984.

The former Camp Hero is now used as Camp Hero State Park, owned by the State of New York, and operated under the jurisdiction of the New York State Office of Parks, Recreation, and Historic Preservation (NYSOPRHP). In 2002, the AN/FPS-35 Radar Tower and Antenna was listed under the

National Register of Historic Places (NRHP). Camp Hero State Park as a whole is potentially eligible for listing on the NRHP according to the New York State Historic Preservation Office.

1.2.3 Previous Investigations

Previous investigations at Camp Hero included underground storage tank (UST) and aboveground storage tank (AST) closures and reports, focused site assessments, and sitewide surveys and reports. Key reports that provide historical data for Camp Hero are briefly summarized below:

- ***UST and AST Closure Reports.*** With the exception of four USTs and ASTs (and one drum area) that are currently listed as in-use at Camp Hero by the Suffolk County Bureau of Hazardous Materials Storage, Office of Pollution Control, all of the USTs and ASTs have been removed at Camp Hero. All USTs and ASTs with reported petroleum releases and respective New York State Department of Environmental Conservation (NYSDEC) spill case numbers have a case closed status with NYSDEC. Analytical data from the closure reports at USTs 30 and 34 indicated that lead was present at concentrations that exceed screening criteria, and further characterization is required. Details of the UST and AST closure reports are included in **Appendix D**, the Technical Memorandum (Records Review January 2016).

- ***Building 203 Site Assessment Report (1994).*** The 1994 Site Assessment Report documents the excavation of former diesel USTs 16 and 18 at former Building 203, where 2,500 yards of diesel-impacted soil were removed. Geoprobe® borings were conducted around and within excavation, and confirmatory soil and groundwater samples were collected. The results of the soil and groundwater samples were below screening criteria (USACE 1994). The Spill Report Case was closed by the NYSDEC in July 1995.

- ***Feasibility Study and Hazardous Materials Survey Preliminary Report (1998).*** The 1998 Camp Hero Feasibility Study and Hazardous Materials Survey Preliminary Report identified several areas that had an actual or potential Hazardous and Toxic Waste (HTW) presence based on the presence of former military buildings and refuse found onsite. In addition to the HTW, projectile fragments were discovered along the southern bluffs of the site (Area K), indicating the potential presence of ordnance and explosives (OE). The 1992 study did not collect any analytical samples, with the exception of one PCB sample collected in an area of oil staining under electrical equipment in Battery 113 (Cashin Associates 1998).

- ***Data Collection Report (2000).*** The 2000 Data Collection Report investigated potential soil and water contamination within select areas at Camp Hero in support of a decision regarding whether further environmental action was required. Concrete chip, surface and subsurface soil, groundwater, and sediment samples were collected and compared against applicable regulatory criteria or guidelines (Weston, Inc. 2000). Conclusions from the investigation included:

- The oil stains on the concrete floors of Building 107 and the Radar Tower (Building 201) contained concentrations of polychlorinated biphenyl (PCBs) that exceed the Toxic Substances Control Act (TSCA) unrestricted use limit of 1 mg/kg. However, the oil stains provided no significant human health or ecological threats via migration.
- PCBs were detected in one surface soil sample above criteria near the radar tower, but no PCBs were detected above the regulatory criteria in adjacent samples collected within 50 ft.
- Subsurface soil samples at the former Power Plant indicated elevated levels of beryllium. Groundwater samples indicated elevated levels of chromium and lead.

A historical records review was conducted in 2015 as part of this RI, which identified 45 potential Areas of Concern (AOCs) at Camp Hero (two additional AOCs were added during the Phase I RI field investigation in 2016, for a total of 47 AOCs). The potential AOCs included former waste disposal areas, former coal storage areas, abandoned drum locations, possible and former USTs, former ASTs, and a Motor Pool building, among others. Findings from the records review are documented in the Technical Memorandum (Records Review January 2016), included as **Appendix D** to this RI Report. The purpose of the Technical Memorandum is to present the findings of the records review task and outline the proposed RI sampling approach at each of the potential AOCs.

Since 2000, the USACE has been conducting various OE investigations in areas not included with the hazardous, toxic, and radioactive waste (HTRW) investigation that is the subject of this RI Report. As such, a summary of historical investigations related to OE is not provided. However, ordnance explosive and non-ordnance scrap was removed from Area H and part of Area K in 2003. No material documented as an explosive hazard requiring detonation was found. Accordingly, potential risk to the public is considered low. Based on the Unexploded Ordnance (UXO) Probability Assessment for Intrusive Investigation at Former Camp Hero completed by USACE Baltimore District, it was determined that the Camp Hero site activities have a low probability of encountering munitions and explosives of concern (MEC) except at Areas H and K, which were not entered during RI field activities. Nevertheless, an unexploded ordnance safety technician was present during intrusive activities conducted during all phases of this RI, and no MEC was discovered.

1.2.4 Remedial Investigation Dataset

The RI technical approach consisted of three phases of investigation: Phase I, Phase II, and Phase III. The full details of each Phase of investigation are provided in Section 2.0 of this RI Report. The primary objectives of each phase, along with the available dataset obtained during each phase, are briefly described below. In the descriptions below, biased samples were collected from locations designed to target the most likely potential source areas. Unbiased samples were collected from a pre-determined pattern within a representative exposure area (i.e., evenly-spaced grid for DUs, regular points along the SEAs). The unbiased samples were collected in sufficient quantity to perform statistical calculations, including calculation of exposure point concentrations (EPCs) for use in risk assessments.

- ***Phase I RI Field Investigation.*** The Phase I investigation was conducted between 16 May and 24 June 2016 as a CERCLA Site Inspection (SI)-level investigation with the primary objective of determining the presence or absence of potential impacts from former DoD activities. A total of 47 potential AOCs, which were established based on the records review completed as part of this RI, were investigated during Phase I. The sampling design for the Phase I program consisted of discrete, biased sampling to target the most likely potential source areas. Phase I activities included a geospatial survey of archived aerial photography, digital geophysical mapping of select AOCs, collection of biased surface and subsurface soil samples for use in the PSE, and collection of grab (unfiltered) groundwater samples for use in refining the groundwater conceptual site model (CSM). The Phase I Investigation Field Report and laboratory analytical data reports are provided in **Appendix E**.

- ***Phase II RI Field Investigation.*** The Phase II RI field investigation was conducted between 28 November and 16 December 2016, and primarily focused on one specific area (the former Building 203 AOC, now DU01) where petroleum impacts to the subsurface were identified during the Phase I effort. The primary objective of Phase II was to delineate the extent of petroleum impacts at this location, including residual light non-aqueous phase liquid (LNAPL). The Phase II RI field investigation activities also included the installation, development, and sampling of 15 permanent background monitoring wells for the collection of sitewide background groundwater data. Phase II activities at the former Building 203 AOC included subsurface screening for LNAPL with Laser Induced Fluorescence (LIF); surface soil sample collection on an unbiased grid; discrete, biased subsurface soil sampling to further evaluate the extent of LNAPL impacts; and groundwater sample collection from six newly-installed permanent monitoring wells. Additionally, a sitewide surface water drainage survey and habitat surveys of multiple AOCs were conducted. The Phase II Investigation Field Report and laboratory analytical data reports are provided in **Appendix F**.

  After completion of the Phase II investigation, the PSE was completed using the Phase I and II RI datasets to: (1) determine which AOCs require further assessment as part of the Phase III RI field effort and (2) refine the list of parameters for sample collection during the Phase

III RI field effort, with the intent of finalizing the RI phase of the CERCLA process. The PSE is provided as **Appendix G**. Based on the PSE, 21 AOCs plus six segments of the sitewide waste disposal system AOC warranted further assessment and were grouped into 18 geometric Decision Units (DUs) for the Phase III investigation. Streams in the vicinity of the DUs were grouped into eight stream exposure areas (SEAs) for the assessment of surface water and sediment.

- ***Phase III RI Field Investigation.*** The Phase III RI field investigation was conducted between 30 May and 28 June 2017. The primary objective of Phase III was to complete the RI phase of the CERCLA process by collecting an unbiased, representative dataset for potentially impacted surface soil, subsurface soil, sediment, surface water, and groundwater media. This was accomplished by:

  – Collecting and analyzing unbiased, representative samples from potentially impacted surface and subsurface soil associated with each of the individual DUs,

  – Collecting and analyzing representative background samples for surface water and sediment at a sitewide scale,

  – Collecting and analyzing an unbiased, representative surface water and sediment dataset in exposure areas in the vicinity of DUs that could potentially impact downgradient surface water and sediment,

  – Establishing a representative groundwater monitoring well network and collecting and analyzing groundwater samples on a sitewide scale, as well as on a local scale in the vicinity of DUs that could potentially (or have been demonstrated to) have localized groundwater impacts, and

  – Collecting additional physical and chemical samples to support the CSM, risk assessments, and Feasibility Study (FS), if required based on the results of the RI.

  The Phase III Investigation Field Report and laboratory analytical data reports are provided in **Appendix H**.

1.3 Report Organization

This RI Report is organized into the following sections:

- **Section 1.0: Introduction** – provides an introduction to the project including the scope and objectives, installation background, previous investigations, the available RI dataset, and the organization of this RI Report.

- **Section 2.0: Field Investigations** – provides descriptions of the field investigation activities for the Phase I, Phase II, and Phase III investigations, a summary of the PSE, and a data usability assessment, including a discussion of Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS). Additional details of the field investigations, including the data analysis and validation process, are provided the Field Report for each phase (**Appendix E** through **Appendix H**).

- **Section 3.0: Physical Characteristics** – provides a sitewide overview of the physical characteristics of the study area, including the site description and current use, climate, topography and geology, hydrology and hydrogeology, and habitat and biota.

- **Section 4.0: Nature and Extent of Contamination** – presents the nature and extent of contamination, in addition to the CSM for each individual DU, each individual SEA, and sitewide groundwater at Camp Hero.

- **Section 5.0: Chemical Fate and Transport** – presents the fate and transport of chemicals posing potential risks at Camp Hero.

- **Section 6.0: Risk Assessment** – includes a summary of the HHRA and ERA. The complete HHRA is included as **Appendix M.** The complete ERA is included as **Appendix N**.

- **Section 7.0: Summary and Conclusions** – provides the summary and conclusions of the RI.

- **Section 8.0: References** – lists the references used in this RI Report.

The following appendices are included in this RI Report:

- **Appendix A** contains the figures referred to in this RI Report.

- **Appendix B** contains the tables referred to in this RI Report. **Appendix B1** provides the tables referenced in the main body of the report. **Appendix B2** provides comprehensive tables of analytical results.

- **Appendix C** contains memoranda and reference material documenting significant components of the analytical data evaluation, including documentation of the PAHs and PCBs totals calculations, the memorandum on the *Technical Approach to Determining the Chromium Ratio*, the memorandum on the *Data Gap from Phase III Field Event, Filtered Surface Water Samples for Dissolved Metals*, and the memorandum on the *Uncensored Data Analysis*.

- **Appendix D** contains the Technical Memorandum (Records Review January 2016), which presents the findings of the records review task of this RI and outlines the proposed RI sampling approach at each of the AOCs established.

- **Appendix E**, **Appendix F**, and **Appendix H** contain the Phase I, Phase II, and Phase III Investigation Field Reports, respectively. The Field Reports document the activities completed and samples collected during each phase of field investigation, and provide the laboratory analytical data reports from each phase.

- **Appendix G** contains the Preliminary Screening Evaluation, which was completed using the Phase I and II RI datasets to determine which AOCs required further assessment and to refine the list of parameters for collection during the Phase III RI field effort.

- **Appendix I** contains the Monitoring Well Construction Logs. Additional field documentation is presented in the attachments to the Field Reports.

- **Appendix J** contains analyses of the physical characteristic field data collected at DU01, including hydraulic conductivity and transmissivity. **Appendix J1** includes the Hydraulic Conductivity Analysis, which presents the results and evaluation of the aquifer (slug) tests completed at five monitoring wells at DU01. **Appendix J2** includes the LNAPL Bail-down Test Results for the bail-down tests completed at one monitoring well and one piezometer at DU01.

- **Appendix K** contains the Groundwater Potability Assessment, which assesses whether perched groundwater at Camp Hero could be considered a potential potable water source. The analysis shows that the shallow perched groundwater at Camp Hero is not suitable as a potable water source.

- **Appendix L** contains the Background and Geochemical Evaluations that distinguish natural or background conditions from DoD-related chemicals. The findings from these evaluations were incorporated into the HHRA and the ERA to focus the risk assessments, and the RI, on DoD-related chemicals. **Appendix L1** contains the Background Study, which documents the derivation of background threshold values (BTVs) in soil, groundwater, surface water, and sediment, and the population comparison hypothesis testing completed in support of the risk assessments. **Appendix L2** contains the Geochemical Evaluation, which distinguished naturally occurring levels of metal concentrations from anthropogenic contamination that may or may not be site-related, and determined which metals, by media and DU/SEA, should move forward through the HHRA and the ERA.

- **Appendix M** contains the HHRA, which evaluates whether chemicals present in surface soil, subsurface soil, sediment, surface water, or groundwater, and attributable to past Camp Hero activities, have the potential to cause unacceptable adverse health effects to human receptors.
- **Appendix N** contains the ERA, which evaluates whether chemicals present in surface soil, sediment, or surface water, and attributable to past Camp Hero activities, have the potential to cause unacceptable adverse health effects to ecological receptors.

2.0 FIELD INVESTIGATIONS

This section provides an overview of the field investigations completed for the Camp Hero RI program. The RI technical approach consisted of three phases of field investigation: Phase I, Phase II, and Phase III. The Phase I field investigation was completed from May to June 2016, the Phase II field investigation was completed from November to December 2016, and the Phase III field investigation was completed from May to June 2017. Each phase of investigation was documented in a Field Report, which are included as **Appendix E**, **Appendix F**, and **Appendix H** of this RI Report. Field logs and records are provided as attachments to the Field Reports, with key results summarized in tables.

Except as specifically noted in this section, the field investigations were conducted in accordance with the approved planning documents, which included the RI Work Plan (AECOM-Tidewater JV 2016), Phase II RI Work Plan Addendum (AECOM-Tidewater JV 2017a), and Phase III RI SAP (AECOM-Tidewater JV 2017b). Figures discussed in this section are presented in **Appendix A**. Tables discussed in this section are presented in **Appendix B1**, while tables of all analytical results are presented in **Appendix B2**.

2.1 Coordination with Stakeholders

Project kick-off meetings were held prior to each phase of work to initiate coordination with stakeholders. Activities were coordinated with Camp Hero State Park Superintendent Tom Dess to ensure activities did not impact park visitors or conflict with seasonal work restrictions. Additionally, activities were coordinated with the State Historic Preservation Officer and other interested parties and stakeholders, in accordance with Section 106 of the National Historic Preservation Act of 1996, as amended and 36 Code of Federal Regulations (CFR) 800.

The New York Natural Heritage Program (NYNHP) and NYSOPRHP were consulted regarding Camp Hero RI activities, with particular focus on the botanical survey of rare and endangered species (additional details in **Appendix E**). Coordination letters were submitted to the NYSDEC Region 1 Office, the United States Fish and Wildlife Service (USFWS) New York Field Office, and the Shinnecock Nation regarding planned Camp Hero activities. The coordination letters indicated the USACE's intent to conduct a RI at Camp Hero, with the purpose of assessing whether the former DoD activities may have resulted in adverse environmental conditions. The letters additionally explained the scope of the project, and stated that care will be taken to minimize impacts to vegetation and local threatened and endangered species. Copies of coordination correspondence are available in the Phase I Investigation Field Report (**Appendix E**).

2.2 Phase I Field Investigation

The Phase I field investigation was conducted from 16 May to 24 June 2016. The primary objective of the Phase I RI field investigation was to confirm the presence or absence of potential DoD-related constituents at Camp Hero AOCs. An additional objective of the Phase I field investigation was to collect a robust set of background soil samples to establish park-wide background levels for naturally occurring constituents and anthropogenic impacts. Based on records review and previous investigations (described above in Section 1.2.3), 45 potential AOCs needing investigation were identified in the RI WP (AECOM-Tidewater JV 2016). The potential AOCs included former waste disposal and coal storage areas, abandoned drum locations, and former storage tanks. Two additional AOCs (Suspected Tank H and Former Building 34) were established during the field activities completed for the Phase I investigation, for a total of 47 AOCs. The complete list of the AOCs included in the Phase I field investigation is presented in **Table 2-1**. The locations of the AOCs are shown on **Figure 2-1**. The sitewide waste disposal system shown on **Figure 2-1** is further detailed on **Figure 2-2** for reference.

The Phase I Investigation Field Report is included as **Appendix E** of this RI Report and provides: (1) documentation of the Phase I field activities, (2) details on any significant deviations from the RI WP (AECOM-Tidewater JV 2016) that occurred, and (3) field data and analytical laboratory reports for samples collected during the Phase I field investigation. The Phase I Investigation Field Report was prepared immediately following the Phase I field effort, and the overall approach and design of the RI evolved following the completion of the Phase I Field Report.

The Phase I RI field investigation at Camp Hero included the following activities:

- Aerial photography archival research and a geospatial survey performed by the U.S. Army Geospatial Center,
- Digital geophysical mapping (DGM) surveys,
- A botanical survey for rare and threatened plant species,
- UXO anomaly avoidance,
- Community air monitoring,
- Collection of background soil samples,
- Collection of discrete, biased surface and subsurface soil samples,
- Collection of unfiltered, grab groundwater samples,

- Building surveys for potentially hazardous materials,
- Limited collection of concrete chip, wipe, and liquid characterization samples,
- The removal of a boiler from the Camp Hero State Park bluffs,
- Land surveying,
- Investigation-derived waste (IDW) management, and
- Data validation.

A summary of key activities is provided below. The full details of the work completed at each AOC are provided in the Phase I Investigation Field Report (**Appendix E**).

Prior to the Phase I sampling activities, DGM surveys were conducted at 15 AOCs to verify any suspected underground storage tanks (USTs) and subsurface historical infrastructure. In general, soil and/or groundwater samples were only collected at AOCs with a positive identification of subsurface appurtenances. Field survey methods consisted of a combination of electromagnetic DGM and/or magnetic Analog Geophysical Mapping (AGM) metal detection surveys (using a magnetometer). At four of the AOCs included in the surveys, only a magnetic AGM survey was conducted. The objectives of the geophysical surveys were to verify the outline of a tank (if it still existed), identify the extent of residual subsurface features, and examine the general vicinity to support safe subsurface sampling within close proximity to the structures. During the DGM survey around Building 22, an additional tank-sized anomaly was identified just north of Building 109. This anomaly was designated as Suspected Tank H and was investigated as a separate AOC.

Tanks or subsurface anomalies were not identified during the DGM survey at 10 of the 15 AOCs investigated; therefore, soil and/or groundwater samples were not collected at these AOCs during the Phase I field investigation. Subsurface anomalies were identified at the remaining five AOCs (Suspected Tank B [STB], Suspected Tank C, Suspected Tank H, the Fuel Pump House, and Plotting Room 113). Small "test holes" using shovels were conducted at the Suspected Tanks B, C, and H locations to confirm the presence of a tank and the need for sample collection. No evidence of a tank or petroleum-contaminated soil was identified at Suspected Tanks C or H; therefore, soil and groundwater samples were not collected at these AOCs. At the STB location, although evidence of a tank was not identified, a petroleum odor was noted in the uncovered soil, which led to the collection of samples at this AOC during the Phase I investigation.

Building surveys for potential hazardous materials were completed at two AOCs, Battery 113 and Building 107. At Battery 113, the survey verified the presence of two 150-gallon diesel ASTs, standing water in two sub-slab open pits, and stained concrete with potential PCB contamination near a former transformer. The field team determined that fluid was still present in the two diesel ASTs and one characterization sample was collected for fuel analysis, ignitability, and toxicity for the purposes of disposal. One liquid characterization sample was collected from one of the open pits for analysis of VOCs, SVOCs, PCBs, and metals. Additionally, one wipe sample and one concrete chip sample was collected from the oil-stained surface for analysis of PCBs.

At Building 107, the survey verified that parts of the wall-mounted transformer were still present in the basement. Three samples were collected for analysis of PCBs: one sample of the dried fluid, one wipe sample on the surface of the stained transformer, and one concrete chip sample within the stained area. Additionally, paint and jet hydraulic oil cans were identified in Building 10, which were likely left by military activities at the site. Building 10 was not included as an AOC in the Phase I RI WP as there was not any indication of a CERCLA release, but the cans of paint and oil were inventoried during the Phase I field effort at the request of the USACE. The apparent *de minimus* leakage of electrical oil resulting in the staining of the interior concrete floor of Building 107 and the dismantling of abandoned electrical equipment will be separately addressed under the FUDS Program.

During the Phase I field investigation, 62 surface soil and 110 subsurface soil samples were collected at 34 AOCs. The sampling design consisted of biased sampling to target the most likely potential source areas. The analyses performed varied between each AOC based on the reasons for concern at that AOC, and included VOCs, SVOCs, energetics (munitions), PCBs, and metals. Hexavalent chromium and mercury were not included in the analytical suite during the Phase I field investigation as these constituents were not considered to be DoD-related based on the historical records search. In accordance with NYSDEC Commissioner's Policy (CP)-51, soil samples at suspected petroleum storage tank AOCs were analyzed for petroleum compounds by the NYSDEC Spills Technology and Remediation Series (STARS) list for either fuel oil or gasoline, which included VOCs, SVOCs, and lead, based on the suspected fuel type (NYSDEC 2010a). A summary of the samples collected and analyses evaluated at each AOC is presented in the Phase I Investigation Field Report (**Appendix E**).

Additionally, 62 background soil samples (30 surface soil and 32 subsurface soil) were collected from four different locations within Camp Hero (BG01 through BG04) representing two different soil types, Whitman sandy loam (WSL; outwash deposits of stratified sand and gravel) and Montauk loam (ML; glaciofluvial deposits of stratified sand and gravel in forms of kames). These two soil types characterize the soil types where most of the Camp Hero RI AOCs are located, excluding urban soil complexes, which are not representative of background conditions. Background soil samples were analyzed for metals and polycyclic aromatic hydrocarbons (PAHs). The PAHs were analyzed by method 8270D in SIM mode to obtain lower detection limits. PAHs were included in the background analysis because they tend to be ubiquitous in the environment and may be derived from both non-anthropogenic and anthropogenic influences not directly related to former military activities at Camp Hero.

During the Phase I field investigation, 66 unfiltered, grab groundwater samples were collected from temporary wells between 24 AOCs. The sampling design consisted of biased sampling to target the most likely potential source areas. Groundwater samples were collected from temporary wells installed during the drilling activities at locations where groundwater was encountered in the borings. The temporary wells consisted of polyvinyl chloride (PVC) with a 5- or 10-ft screen in an open borehole with no sand or filter pack. The analyses performed varied between each AOC, based on the reasons for concern at that AOC, and included VOCs, SVOCs, energetics, PCBs, and metals. A summary of the samples collected and analyses evaluated at each AOC is presented in the Phase I Investigation Field Report (**Appendix E**).

In addition to soil and grab groundwater sample collection, the Phase I field investigation at the former Building 203 AOC (now DU01) included the installation of three piezometers (PZ-1 through PZ-3) upgradient and downgradient of the former Building 203 to determine radial groundwater flow and direction in the vicinity; groundwater samples were not collected from these locations. Upon gauging the piezometers, approximately 5 ft of LNAPL was observed in piezometer PZ-3. The thickness was measured to be 5.30 ft (8.00 to 13.30 ft bgs) using an interface probe. A petroleum release notification for the former Building 203 AOC was made to the NYSDEC hotline by the USACE. Pollution Complaint Number PC-1602757 was assigned to the reported release. The Camp Hero State Park Superintendent (Mr. Tom Dess) was also notified that the release had been reported to NYSDEC.

The Phase I RI field investigation was generally completed according to the scope provided in the RI WP. Although the overall objectives were met, some deviations to the RI WP and field decisions occurred during the field effort following discussions between the PDT. For example, a survey of the Battery 112 AOC was recommended in the RI WP to confirm that ASTs were not present and to complete a visual inspection for evidence of PCB-contaminated stained concrete. However, Battery 112 was completely sealed and safe access was not possible; therefore, work was not completed at Battery 112. Additionally, the field team was unable to locate debris noted by the previous Feasibility Study and Hazardous Materials Survey Preliminary Report at AOCs H-7 and H-8 (Cashin Associates 1998), despite an extensive visual and magnetometer survey. The full list of field decisions and deviations from the RI WP are documented in the Phase I Investigation Field Report (**Appendix E**).

Data validation was conducted on the Automated Data Review (ADR) output for the Camp Hero analytical data. The ADR.net program performed an automated data review of the project samples and produced validation outlier reports and assigned qualifiers; the reports and qualifiers were reviewed and approved by the project chemists. Analytical data packages were validated at level 2a to ensure compliance with specified analytical QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria. Analytical results were assessed for accuracy and precision of the laboratory analysis to determine the limitations and quantity of data. The quality of the data collected in support of the sampling activity was considered acceptable.

Data validation memos are provided in the Phase I Investigation Field Report (**Appendix E**), along with the complete details of the data validation process. Additionally, a data usability assessment, including a discussion of PARCCS, is included as Section 2.6.

2.3 Phase II Field Investigation

The Phase II field investigation was conducted from 28 November to 16 December 2016. The primary objectives of the Phase II RI field investigation included installation, development, and sampling of 15 permanent background monitoring wells for the collection of sitewide background groundwater data for total and dissolved metals. The objectives also included further evaluation of the former Building 203 AOC (now DU01), which was prioritized in the Phase II RI field investigation due to concerns about petroleum impacts to soil and groundwater observed in the Phase I investigation. Additionally, habitat surveys of AOCs across the site were conducted and a sitewide survey of streams and surface water drainage features was completed. AOCs other than the former Building 203 warranting additional analytical sampling based on the PSE were addressed during the Phase III RI field investigation (Sections 2.4 and 2.5).

The Phase II Investigation Field Report is included as **Appendix F** and provides: (1) documentation of the Phase II field activities, (2) details on any significant deviations from the Phase II WP Addendum (AECOM-Tidewater JV 2017a) that occurred, and (3) field data and analytical laboratory reports for samples collected during the Phase II field investigation.

The Phase II RI field investigation at Camp Hero included the following activities:

- A botanical survey for rare and threatened plant species in areas of drilling operations,
- Habitat surveys of Camp Hero AOCs sitewide,
- A sitewide survey of streams and surface water drainage features,
- UXO anomaly avoidance at the former Building 203 AOC prior to sampling,
- Community air monitoring at the former Building 203 AOC during sampling,

- Monitoring well installation and development,
- Bail-down tests of LNAPL in two wells at the former Building 203 AOC,
- Collection and analysis of background groundwater samples,
- Collection and analysis of soil and groundwater samples associated with the former Building 203 AOC (now DU01),
- Subsurface screening for petroleum with Laser Induced Fluorescence (LIF) at the former Building 203 AOC,
- IDW management, and
- Data validation.

A summary of key activities is provided below. Additionally, a summary of the Phase II field investigation is presented in **Table 2-2**. The full details of each activity are provided in Phase II Investigation Field Report (**Appendix F**).

During the Phase II RI field investigation, 21 monitoring wells were installed, developed, and sampled, including 15 background monitoring wells and 6 monitoring wells at the former Building 203 AOC (DU01). Groundwater samples were collected from 14 of the 15 background monitoring wells and analyzed for total and dissolved metals (including hexavalent chromium). One background monitoring well (CH-MW008) was not sampled as it was considered to have grout contamination based on high pH readings (10+) prior to and after well development.

The Phase II RI field investigation at the former Building 203 AOC (now DU01) included subsurface screening for petroleum with LIF to assist in determining the vertical and horizontal extent of LNAPL. Following the LIF investigations, surface soil sample collection was completed from an unbiased grid of 32 soil borings within the immediate vicinity of the former Building 203 and associated USTs. Subsurface soil samples were collected from the same locations, but were biased to the depth intervals indicating petroleum impacts to further evaluate the vertical and horizontal extent of LNAPL. Soil samples were analyzed for VOCs, SVOCs, and metals (including hexavalent chromium).

Groundwater samples were collected from five of the six monitoring wells at the former Building 203 AOC (DU01) and analyzed for VOCs, SVOCs, and metals. Total groundwater (unfiltered) and dissolved groundwater (filtered) samples for metals were collected at each well (including hexavalent chromium). The sixth well (CH-MW017) contained LNAPL, and therefore a sample was not collected. Bail-down tests were completed at two well locations containing LNAPL. At the first well (CH-MW017), LNAPL measured approximately 2 ft in thickness initially and returned to 2.8 ft of product after four days. At the second location (PZ-3), LNAPL measured approximately 9 ft of thickness initially and recovered to 0.2 ft of thickness after four days. Fuel fingerprint analysis of a LNAPL sample was completed at the analytical laboratory and indicated that the LNAPL was weathered diesel (#2 fuel oil), which matches the type of fuel that was purportedly stored in the USTs associated with former Building 203.

The Phase II RI field investigation was generally completed according to the scope provided in the RI WP Addendum. Although the overall objectives were met, some deviations to the Phase II WP Addendum and field decisions occurred during the field effort following discussions between the PDT. For example, groundwater at three background wells (CH-MW007, CH-MW011, and CH-MW021) was insufficient to complete sampling via low-flow methodology. Instead, grab groundwater samples were collected at these locations. The full list of field decisions and deviations from the RI WP Addendum are documented in the Phase II Investigation Field Report (**Appendix F**).

Data validation was conducted on the ADR output for the Phase II analytical data. The ADR.net program performed an automated data review of the project samples and produced validation outlier reports and assigned qualifiers; the reports and qualifiers were reviewed and approved by the project chemists. All analytical data packages were validated at level 2a. The quality of the data collected in support of the sampling activity was considered acceptable. Data validation memos are provided in the Phase II Investigation Field Report (**Appendix F**). A data usability assessment, including a discussion of PARCCS, is included as Section 2.6 of this RI Report.

In September 2017, the laboratory subcontracted for completing Phase II and III analyses (Eurofins Lancaster Laboratories Environmental, LLC [ELLE]) provided notification that some metals data had compromised quality, which affected samples collected during both the Phase II (affecting 4 sample delivery groups [SDGs]) and the Phase III field investigations (affecting 29 SDGs). The affected data packages from the Phase III investigation are discussed in Section 2.5 of this RI Report. Approximately 1,360 analytical metals results from 59 Phase II samples were affected. An evaluation of this concern was conducted by ELLE and reviewed by AECOM project chemists. Of the potentially affected Phase II data, only one sample result (0.07% of the 1,360 results) required an actual value change, and one sample result (0.07%) required a qualifier change. Following the rigorous review, all revised data for the Phase II field investigation was deemed usable. Additional details regarding the laboratory data breach are discussed in the Phase II Investigation Field Report (**Appendix F**).

2.4 Preliminary Screening Evaluation

A PSE of the existing Camp Hero dataset was conducted after the Phase I and II field investigations to (1) determine which AOCs needed further evaluation and sampling during the Phase III RI field investigation and (2) refine the list of analytes for sample collection during the Phase III RI field investigation. Results of the PSE are presented in **Appendix G** of this RI Report and were previously included in the Phase III RI SAP (AECOM-Tidewater JV 2017b).

The following datasets for the PSE were collected during the Phase I and Phase II field investigations at Camp Hero:

- ***Phase I RI Field Investigation (2016).*** Phase I activities included the collection of discrete, biased surface and subsurface soil samples for use in the PSE. Grab groundwater samples were also collected for use in refining the groundwater conceptual site model (CSM) but were not included in the PSE.

- ***Phase II RI Field Investigation (2017).*** Phase II activities at the former Building 203 AOC included discrete biased subsurface soil sampling for use in the PSE. Phase II activities also included surface soil sample collection on discrete, unbiased grids and groundwater sample collection from six newly installed, permanent monitoring wells to support the groundwater CSM. Surface soil and groundwater samples were not included in the PSE, as they were collected for use in the risk assessment.

From these datasets, the maximum detected concentration for each analyte in surface and subsurface soil was compared to the most conservative applicable screening criteria and the site-specific background threshold values (BTVs). Applicable screening criteria are detailed in the PSE (**Appendix G**). If no analytes at an AOC exceeded the screening criteria or BTVs, the AOC was identified for no further action (NFA) under the CERCLA process. However, if any analyte exceeded the screening criteria and the BTVs, then that AOC was identified as requiring further assessment. Additional considerations in evaluating AOCs for further assessment included the results of the DGM surveys (provided in **Appendix E**, the Phase I Investigation Field Report), an evaluation of AOCs in the context of CERCLA, an evaluation of the types of analytes in exceedance at each of the AOCs, and field observations. In some instances, AOCs were also recommended for further assessment if field observations or measurements indicated evidence of a potential release.

Based on the results of the PSE, results of the geophysical surveys, or an evaluation of potential CERCLA releases, 25 AOCs, plus a portion (8 of 14 segments) of the WDS AOC, warranted NFA. A total of 21 AOCs, plus a portion (6 segments) of the WDS AOC, warranted further assessment as part of the Phase III investigation. These AOCs either had constituents in surface or subsurface soil exceeding preliminary screening values and BTVs, or field evidence of a potential release, including petroleum odor or sheen on groundwater from temporary wells. A summary of the PSE and recommendations for the Phase III field investigation are presented in **Table 2-3**. Additional details regarding the PSE are provided in **Appendix G**.

2.4.1 Selection of Decision Units for Further Investigation

The AOCs warranting additional sampling based on the PSE were grouped into 18 geometric DUs for the Phase III investigation (DU01 through DU18), as established in the Phase III SAP (AECOM-Tidewater JV 2017b). The purpose of establishing DUs was to provide a realistic exposure area that was representative for both human health and ecological receptors. Soil sampling could then be conducted within the DUs in an unbiased manner to produce a statistically robust dataset that could be used to refine the CSMs and establish representative EPCs.

The DUs were set at approximately 0.5- or 1-acre exposure areas, consistent with the extent of potential impacts from prior investigations and the expected range of typical human health and ecological receptor exposure areas. In general, the DUs were designed as geometric squares, but the sampling protocol within the DUs was adjusted where appropriate, to account for site conditions such as nearby fences, roads, steep slopes, streams, or significant geographic features. Sample collection and sample depths varied in areas with limited accessibility within each of the DUs (additional details in Section 2.5); however, the entire DU boundary is still considered the exposure area for quantification of potential risks to receptors. Media and analytes evaluated at each DU during the Phase III field investigation varied between each DU and were established based on the PSE. **Table 2-4** presents the DU groupings for the Phase III RI field investigation. The location of each DU relative to the Phase I AOCs warranting further assessment is shown on **Figure 2-3**. Further details on the evaluation of prior analytical results and the selection of DUs for further study are provided in the PSE (**Appendix G**).

2.4.2 Selection of Stream Exposure Areas for Further Investigation

A sitewide network of surface water and sediment samples was established for the Phase III RI field investigation to assess potential environmental impacts from the various DUs on the network of streams within the Camp Hero investigation area. Surface water and sediment sample locations within the sitewide network were grouped into linear SEAs for the assessment of potential DU contributions, as well as broader stream conditions along longer stretches of the channels. The SEAs included samples that were upstream, adjacent, and downstream of DUs or groups of DUs. The goal of sampling within the SEAs was to create a robust dataset for surface water and sediment, and to establish representative EPCs from a realistic exposure area for potential human health and ecological receptors.

Based on the PSE of the soil data, SVOCs and metals warranted further assessment in surface and subsurface soil at the majority of the DUs; therefore, to ensure data were comparable at a sitewide scale, all surface water and sediment samples were evaluated for SVOCs and metals at minimum. Additional parameters for surface water and sediment were evaluated at individual SEAs, as necessary, depending on the CSM of the nearby DUs. Because many of the streams at Camp Hero transect multiple DUs, some sample locations could be downstream of one DU but upgradient of another; however, the entire linear SEA is still considered the exposure area for quantification of potential risks to receptors. **Table 2-4** presents the SEA groupings for the Phase III RI field investigation, and the location of each SEA to assess potential impacts from nearby DUs is shown on **Figure 2-4**.

2.5 Phase III Field Investigation

The Phase III field investigation was conducted from 30 May to 28 June 2017. The primary objectives of the Phase III field investigation were to collect an unbiased, representative dataset for potentially impacted surface and subsurface soil associated within the 18 soil DUs; collect a representative background dataset for surface water and sediment at a sitewide scale; collect unbiased, representative surface water and sediment data within SEAs in the vicinity of DUs that could potentially impact downgradient surface water and sediment; establish a representative sitewide groundwater monitoring well network and collect groundwater samples on a sitewide scale, as well as on a local scale in the vicinity of DUs that could potentially have localized groundwater impacts; and collect additional physical and chemical data to support the development of the RI CSM, risk assessments, and FS (if required based on the results of the RI). The locations of the DUs and the sitewide monitoring well network are shown on **Figure 2-4**. The sitewide surface water and sediment sampling locations are shown on **Figure 2-5**.

The Phase III Investigation Field Report is included as **Appendix H** and provides: (1) documentation of the Phase III field activities, (2) details on any significant deviations from the Phase III RI SAP (AECOM-Tidewater JV 2017b) that occurred, and (3) field data and analytical laboratory reports for samples collected during the Phase III field investigation.

The Phase III RI field investigation at Camp Hero included the following activities:

- A botanical survey for rare and threatened plant species within the DUs and SEAs,
- Wetland delineation and establishment of best management practices (BMPs) for wetland avoidance and minimization,
- Stream exposure area characterization,
- UXO anomaly avoidance,
- Community air monitoring,
- Monitoring well installation and development,

- Hydraulic conductivity (slug) testing,
- Background surface water and sediment sample collection,
- Collection of soil, groundwater, surface water, and sediment samples,
- Land surveying,
- IDW management, and
- Data validation.

A summary of key activities is provided below. The full details of each activity are provided in Phase III Investigation Field Report (**Appendix H**).

During the Phase III field event, 22 permanent monitoring wells were installed within or immediately downgradient of DUs or in other areas with a high potential for suspected groundwater impacts. This resulted in a sitewide network of 43 total monitoring wells, including the 21 monitoring wells that were installed during the Phase II event (**Figure 2-4**). Groundwater samples were collected from 27 monitoring wells during the Phase III event, including all existing and new monitoring wells with the exception of the 15 background wells and one well with LNAPL present at DU01. Groundwater samples were analyzed sitewide for semivolatile organic compounds (SVOCs) and metals (including hexavalent chromium [in 10% of samples] and mercury). Groundwater in the vicinity of DU01 and DU11 was also analyzed for volatile organic compounds (VOCs), and groundwater in the vicinity of DU15 was analyzed for polychlorinated biphenyls (PCBs). Total groundwater (unfiltered) and dissolved groundwater (filtered) samples were collected at each well. Both filtered and unfiltered samples were collected for SVOCs, PCBs, and metals to assess to impact of particulate matter on concentrations of these parameters.

A sitewide network of 30 co-located background surface water and sediment samples were collected upstream of the DUs and SEAs to establish sitewide background levels for naturally occurring constituents and anthropogenic impacts (**Figure 2-5**). Additionally, a sitewide network of co-located surface water and sediment samples were collected from 125 locations within SEAs for the assessment of potential impacts from DU constituents that could potentially impact downgradient surface water and sediment. Surface water and sediment samples were analyzed sitewide for SVOCs and metals (including hexavalent chromium [in 10% of samples] and mercury); surface water and sediment samples in the vicinity of DU15 were also analyzed for PCBs. A total of 155 sediment samples, 148 unfiltered surface water samples, and 30 filtered surface water samples were collected at Camp Hero (including sitewide and background locations). Both filtered and unfiltered samples were collected for SVOCs, PCBs, and metals to assess to impact of particulate matter on concentrations of these parameters. Filtered surface water samples were collected when the turbidity of the surface water was greater than 10 nephelometric turbidity units (NTUs). Surface water could not be collected at 7 of the 155 locations because they were dry during the field event.

Soil samples were collected at 16 of the 18 DUs during the Phase III field event. Soil samples could not be collected from DU08 as the DU was entirely under water; instead, surface water and sediment samples were collected at DU08. A total of 400 soil samples were collected, including 256 surface soil samples (0 to 1 feet [ft] below ground surface [bgs]) from 16 DUs and 144 subsurface soil samples (1 to 10 ft bgs or 1 to 2 ft bgs in wetlands) from 9 DUs. Analytical parameters for surface and subsurface soil varied by DU based on the data needs established in the PSE and Phase III SAP, but generally included SVOCs and metals (AECOM-Tidewater JV 2017b). Hexavalent chromium was analyzed in 10% of samples analyzed for metals, along with pH and oxidation-reduction potential (ORP). PCBs were also evaluated in soil samples from DU15. Additionally, two undisturbed subsurface soil samples were collected at DU01 by Shelby tube methodology for laboratory analysis of soil permeability.

The Phase III field investigation was generally completed according to the scope provided in the Phase III SAP. Although the overall objectives were met, some deviations to the Phase III RI SAP occurred based on field decisions, and avoidance and minimization best management practices (BMPs) were followed during the field effort following discussions between the PDT. The full list of field decisions and deviations from the SAP are documented in the Phase III Investigation Field Report (**Appendix H**).

One deviation of note was that, due to a misinterpretation of the SAP by the field team, filtered surface water samples were generally only collected when the turbidity was elevated (>10 NTU). Although the Phase III SAP established that filtered samples for organic parameter groups (SVOCs and PCBs) in surface water would only be collected if the turbidity was elevated (>10 NTU), filtered surface water samples were to be collected for dissolved metals analysis regardless of the turbidity. Unfiltered metals in surface water were collected as planned at all locations for a total of 148 samples. However, field-filtered surface water samples were collected from 30 locations during the Phase III field event, inclusive of the sitewide background locations.

To obtain additional filtered surface water data for metals, excess volume from unfiltered surface water samples on hold at the laboratory were filtered in the laboratory and analyzed for metals. A total of 197 surface water samples were used and analyzed for the Phase III metals list per the SAP, except for mercury and hexavalent chromium. The 197 samples included samples from all 148 unfiltered surface water locations, 30 previously analyzed field-filtered locations, and 19 field duplicate locations. Mercury and hexavalent chromium were not analyzed as the samples were approximately 100 days past their respective hold times. The 197 surface water samples (dissolved [field-filtered] and total) from 148 locations were unpreserved and had been kept in cold storage in amber bottles since the Phase III field event. The field-filtered samples were re-filtered and analyzed for comparability.

After consultation with the USACE, the lab-filtered results are considered qualitative data due to the uncertainty of filtering the samples a significant amount of time after the holding times had expired, and the fact that biological activity can occur under cool conditions in an amber bottle. Therefore, the total (unfiltered) water samples represent the primary surface water dataset for the RI. The lab-filtered results are used qualitatively, as needed, in the interpretation of site conditions and the characterization of potential risks. Additional details regarding the lab-filtered surface water dataset for metals are discussed in the Field Report (**Appendix H**) and the memorandum *Data Gap from Phase III Field Event, Filtered Surface Water Samples for Dissolved Metals* (**Appendix C3**).

Data validation was conducted on the ADR output for the Camp Hero analytical data. The ADR.net program performed an automated data review of the project samples and produced validation outlier reports and assigned qualifiers; the reports and qualifiers were reviewed and approved by the project chemists. All analytical data packages were validated at level 2a to ensure compliance with specified analytical QA/QC requirements, data reduction procedures, data reporting requirements, and required accuracy, precision, and completeness criteria. Analytical results were assessed for accuracy and precision of the laboratory analysis to determine the limitations and quantity of data. The quality of the data collected in support of the sampling activity was considered acceptable. Data validation memos are provided in the Phase III Investigation Field Report (**Appendix H**), along with the complete details of the data validation process. Additionally, a data usability assessment, including a discussion of PARCCS, is included as Section 2.6 of this RI Report.

As discussed in Section 2.3, the compromised metals data affected approximately 14,000 analytical metals results from 596 samples in 33 SDGs. This affected 29 SDGs from the Phase III field investigation. Based on the evaluation of this matter conducted by ELLE and the AECOM Camp Hero project chemists, 18 samples collected from DU04 in one Phase III SDG required re-analysis. The reanalyzed metals samples were determined to have acceptable QC parameters and replaced the metals affected by the data breach. Of the remaining potentially affected data, 19 sample results (0.13% of the 15,400 results) required an actual value change, and 226 sample results (1.6%) required qualifier changes. All revised data for both Phase II and Phase III field investigation events were deemed usable. Additional details regarding the laboratory data breach are discussed in the Phase III Investigation Field Report (**Appendix H**).

2.6 Data Usability Assessment

Although the RI data are considered generally usable, some degree of uncertainty is typically encountered. Specific factors that may contribute to the uncertainty of the data evaluation are described below. The following Data Quality Indicators, including Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity (PARCCS), are important components in assessing data usability. The data validation reports for each phase of the field investigation are presented in each of the Field Reports (**Appendix E**, **Appendix F**, and **Appendix H**) and provide explanations for all qualified data in greater detail, as well as an assessment of data usability.

The percentages in the following sections represent the percent of outliers when compared to the entire dataset. Percentages of QC exceedances were calculated by using all the analytes per method that had an issue divided by the total number of usable analytes multiplied by 100%. The non-preferred results were not used in the calculation.

Overall, the dataset is considered acceptable except for a few rejected results presented in the completeness section.

2.6.1 Precision

Precision refers to the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of the repeated application of the same process under similar or prescribed conditions. Precision reflects random error and may be affected by systematic error. It also reflects variation imposed by a given matrix.

Laboratory precision is measured by the variability associated with duplicate (two) analyses. Multiple laboratory control sample (LCS) analyses, LCS/laboratory control sample duplicate (LCSD) relative percent differences (RPDs), and MS/MSD RPDs were evaluated to assess laboratory precision. The LCS recoveries, LCS/LCSD RPDs, and MS/MSD RPDs were within Quality Assurance Policy Plan (QAPP)-specified QC limits, excluding the anomalies presented in the data validation reports which are summarized in the following sections. Total precision is the measurement of the variability associated with the entire sampling and analytical process. The project QC limits for field duplicate samples are RPD ≤ 50% for soil and RPD ≤ 30% for water. Field duplicates do not characterize total measurement precision. The environmental samples collected within the same DU account of total measurement variability. The statistical design automatically takes the variability of these duplicates into account. Therefore, the non-compliant RPDs summarized in this section of the document to not actually affect any decisions. The RPDs for field duplicate pairs for soil and aqueous matrices outside of the QC limits are as follows:

- VOCs by SW-846 8260C at 0.44%

- SVOCs by SW-846 8270D at 1.6%
- PAHs by SW-846 8270D SIM at 5.3%
- PCBs by SW8082A at 0.09%
- Explosives by SW8330B at 0%
- Metals by SW-846 6010C/6020A/7471A at 2.4%
- Hexavalent chromium by SW-846 7199 and 218.6 at 4.7%

2.6.2 Accuracy

Accuracy is a measure of confidence between a measured value and an expected or true value. A smaller difference between the measured value of a parameter and its expected value indicates a more accurate measurement. A more precise or reproducible result is more reliable or accurate. Accuracy was assessed for each method, analyte, and matrix by comparing surrogate, LCS, LCSD, and MS/MSD recoveries to the QAPP-specified QC limits. Low percent recoveries indicate a low bias while high percent recoveries indicate a high bias.

LCSs are prepared by the addition of known concentrations of each analyte to media known to be free of target analytes. LCSs were analyzed for every analytical batch to demonstrate the accuracy of the analytical systems. LCS accuracy limits are matrix- and method-specific. Laboratory control spike duplicate accuracy was expressed as percent recovery and QC limits range between 15% and 180%; laboratory control spike duplicate precision was expressed as relative percent difference and QC limits range between15% and 40%).

The LCS displayed percent recoveries outside of the QC limits is as follows:

- VOCs by SW-846 8260C at 3.7%
- SVOCs by SW-846 8270D at 1.3%
- PAHs by SW-846 8270D SIM at 0.98%
- PCBs by SW8082A at 0%
- Explosives by SW8330B at 0%
- Metals by SW-846 6010C/6020A/7471A at 0.84%
- Hexavalent chromium by SW-846 7199 and 218.6 at 2.0%

A MS pair is prepared, analyzed, and reported for all preparation batches. MS pairs demonstrate that the analytical system was in control for the matrix being tested. MS pairs were analyzed for every analytical batch to demonstrate the ability of the laboratory to recover a concentration of a known quantity in site matrix media. MS/MSD accuracy limits are matrix- and method-specific. Matrix spike duplicate accuracy was expressed as percent recovery and QC limits range between 15% and 180%; matrix spike duplicate precision was expressed as relative percent difference and QC limits range between 15% and 40%.

The MS/MSD performed on parent samples displayed percent recoveries outside of the QC limits is as follows:

- VOCs by SW-846 8260C at 0%
- SVOCs by SW-846 8270D at 3.7%
- PAHs by SW-846 8270D SIM at 3.8%
- PCBs by SW8082A at 9.6%
- Explosives by SW8330B at 0%
- Metals by SW-846 6010C/6020A/7471A at 0%
- Hexavalent Chromium by SW-846 7199 and 218.6 at 0%

Surrogate compounds were added to all field samples and QC samples for organic analyses during sample preparation. Surrogate compounds are substances with properties that mimic the analytes of interest. Surrogate compounds are unlikely to be found in field samples and are added to demonstrate the laboratory's ability to detect a similar compound at a known concentration. Expected surrogate recovery percentages vary depending on the method and matrix, and range between 30% and 150%.

Surrogate percent recoveries not within QC limits is as follows:

- VOCs by SW-846 8260C at 0%
- SVOCs by SW-846 8270D at 3.7%
- PAHs by SW-846 8270D SIM at 3.8%
- PCBs by SW8082A at 9.6%

- Explosives by SW8330B at 0%

Calibration and method blanks consist of media containing no compounds of interest. Calibration blanks are reagent water and are used to determine the zero point for initial and continuing instrument calibrations; calibration blanks above the LOD require laboratory investigation and correction. Method blanks are comprised of media similar to the batch of associated samples; they are prepared and analyzed using the same methodologies as field samples and are used to determine accuracy bias. Analytes in method blanks detected at concentrations greater than the DL may lead to high bias and false positive data.

Percentages of data qualified due to method blank contamination are as follows:

- VOCs by SW-846 8260C at 0.98%
- SVOCs by SW-846 8270D at 0.02%
- PAHs by SW-846 8270D SIM at 0.11%
- PCBs by SW8082A at 0%
- Explosives by SW8330B at 0%
- Metals by SW-846 6010C/6020A/7471A at 0.80%
- Hexavalent chromium by SW-846 7199 and 218.6 at 0%

2.6.3 Representativeness

Representativeness qualitatively expresses the degree to which the data accurately and precisely depicts the characteristics of a population, whether referring to the distribution of chemicals within a sample, a sample within a matrix, or the distribution of a chemical at a site. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences.

Field sample collection, preservation, and shipping were performed in accordance with the UFP-QAPP and field SOPs. No quality issues were observed by the field lead during field activities. All preservation techniques were followed by the field staff, and all technical and analytical holding times were met by the laboratory. The laboratory used approved standard methods as outlined in the UFP-QAPP for all analyses.

Analytes in field-related blanks were detected at concentrations greater than the DL in either the trip blank, or equipment blank samples.

Percentages of data qualified due to blank contamination are as follows:

- VOCs by SW-846 8260C at 1.0%
- SVOCs by SW-846 8270D at 0%
- PAHs by SW-846 8270D SIM at 0.08%
- PCBs by SW8082A at 0%
- Explosives by SW8330B at 0%
- Metals by SW-846 6010C/6020A/7471A at 0.10%
- Hexavalent chromium by SW-846 7199 and 218.6 at 0%

2.6.4 Comparability

Comparability is a qualitative indicator of the confidence with which one dataset can be compared to another dataset. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability was achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms supported the assessment of comparability.

Comparability is the extent to which data from one study can be compared directly to either past data from the current project or data from another study. Using standardized sampling and analytical methods, units of reporting, and site selection procedures helps ensure comparability. Standard field sampling, field documentation using standardized data collection forms, and typical laboratory protocols were used in this investigation.

2.6.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data expected under normal conditions. Project completeness is determined by evaluating the planned versus actual quantities of data. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the dataset. For completeness requirements, valid results are all results not qualified with an R-flag after a usability assessment was performed.

Percent completeness for parameters is as follows:

- VOCs by SW-846 8260C at 99% (the cooler containing sample H17-SB02-GW was received outside temperature [at 22 degrees Centigrade (°C)] due to delayed delivery via FedEx delivery services. For the VOC analyte group, non-detect results were qualified "R" [rejected value] and the detects were qualified "J" [estimated value]).
- SVOCs by SW-846 8270D at 100%
- PAHs by SW-846 8270D SIM at 100%
- PCBs by SW8082A at 100%
- Explosives by SW8330B at 100%
- Metals by SW-846 6010C/6020A/7471A at 100%
- Hexavalent chromium by SW-846 7199 and 218.6 at 100%

2.6.6 Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. The DoD Quality Systems Manual (QSM) measures analytical sensitivity in terms of the Detection Limit (DL), Limit of Detection (LOD), and Limit of Quantitation (LOQ). To meet the needs of the data users, project data must meet the measurement performance criteria for sensitivity and project limits specified in the SAP. To meet measurement quality objectives for analytical sensitivity, the LOD for non-detects and the LOQs for detected concentrations need to be less than the project's decision limits. To achieve the DQOs for sensitivity outlined in the SAP, the laboratory reported all field sample results at the lowest possible dilution. QLs may be greater than the project-required limit of quantitations due to dilutions. The data validators also flagged all positive results greater than the detection limit (DL) and less than the limit of quantification (LOQ) "J," as these positive estimate detections were less than the lowest calibration standard.

All dilutions were performed appropriately and correctly.

3.0 PHYSICAL CHARACTERISTICS

Physical characteristics of the site have been compiled using a combination of literature review, prior reports and site data, and field measurements and observations during the RI field program. Key information is summarized in **Table 3-1** through **Table 3-5** in **Appendix B**, and on **Figure 3-1** through **Figure 3-20** in **Appendix A**.

3.1 Description and Current Use

The former Camp Hero is located on the eastern tip of Long Island, known locally as the South Fork, within Suffolk County, New York, approximately 5 miles east of the village of Montauk (**Figure 1-2**). The Camp is bounded by Montauk Highway (Route 27) to the north, the Atlantic Ocean to the south, Montauk Point State Park to the east, and an undeveloped sanctuary area to the west. The Town of East Hampton owns Turtle Cove Town Park to the east, and a residential area adjacent to the northwest boundary of the park. Main access to the park is from Route 27 onto park roads. The landscape includes wooded areas, freshwater wetlands, and seaside bluffs. A general site layout map of Camp Hero is provided as **Figure 1-2**.

The overall former Camp Hero facility comprises 469 acres, and includes the following current landowners:

- NYSOPRHP (415 acres);
- Town of East Hampton (46 acres); and
- Montauk Historical Society Lighthouse Commission, leased for 30 years from the Department of Transportation, U.S. Coast Guard (6 acres).

The majority of the former Camp is owned by the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP) and is operating as the Camp Hero State Park, a public recreational area (USACE 2003). The Camp Hero main entrance is located at the northeast corner of the park. The park currently contains hiking trails and roadways leading to former military buildings, picnic areas, and recreational areas. One former military building, the Fixed-Pulse Radar Surveillance (FPS)-35 Radar Tower and Antenna (Radar Tower), is listed under the National Register of Historic Places (NRHP). However, the FPS-35 Radar Tower is sealed and in a restricted area from park visitors. Three park buildings are active at this time: the park ranger gate house at the main entrance, a vehicle maintenance building, and a building used as a residence for a Park Police officer. The park property is fenced and the inactive buildings and bunkers have been sealed; however, some portions of these areas may be accessible to trespassers.

Future land use is anticipated to remain the same. Correspondence from NYSOPRHP to the USACE on future park use plans indicated that NYSOPRHP may add new camping areas and new trails to the park (Mr. Brian Foley, Long Island State Parks Region deputy regional director, personal communication, 3 April 2017). The potential future camping areas may be located northwest of DU04, adjacent to DU06 (in a current picnic area), north of Battery 113 (not adjacent to any DUs), and to the east of DU16. Two new hiking trails may also be added to the park trails. A current and potential future land use map is provided as **Figure 3-1**.

The investigation area for this RI was limited to the subset of Camp Hero State Park that contains the footprint of the military operations, excluding the two parcels Area H and Area K. The portions of the former Camp Hero under ownership of the Town of East Hampton and the Montauk Historical Society Lighthouse Commission (U.S. Coast Guard) do not fall within in the study area for this RI. The 46 acres within Camp Hero owned by the Town of East Hampton are used for affordable housing, which consists of 27 former Air Force housing units located along the south side of Montauk Highway (Route 27). The U.S. Coast Guard operates an automated beacon light atop the old lighthouse at Montauk Point. The property around the lighthouse is leased to the Montauk Historical Society Lighthouse Commission and operates as a museum regularly open to the public. Future land use at both parcels is anticipated to remain the same.

3.2 Climate

Camp Hero is subjected to warm, humid summers and mild winters. The annual average rainfall is approximately 44 inches (in). The average quantity of precipitation is almost the same during the cool season (October–March) as during the warm season (April–September). However, precipitation is more frequent in the spring than in the fall. The former Camp Hero is sometimes subject to coastal tropical storms capable of producing high winds and heavy rains in the late summer or fall. Average yearly snowfall is 29 in, with most of the snow falling from December to March. The average annual temperature is 52.2 degrees Fahrenheit (°F). The average temperature during the winter months (December through February) is 30.9°F, and the average temperature during the summer months (June through August) is 71.1°F (EODT 2004).

3.3 Topography and Geology

Long Island is in the Atlantic Coastal Plain Physiographic Province of the United States. The eastern end of Long Island is divided by a series of connected bays and rivers that create two peninsulas known locally as the North and South Fork. Camp Hero State Park is located on the extreme eastern point of the South Fork. Physiographic features of Long Island are dominated by the Ronkonkoma Moraine. The Ronkonkoma Moraine forms an irregular ridge of coalescing hills traversing Long Island from west to east. The surface features of this moraine are characterized by hills and depressions (knob-and-kettle topography) with steep terrain, thickly wooded areas, and densely vegetated wetlands. Within Camp Hero State Park, the hills rise in elevation to approximately 110 ft above mean sea level (amsl). Along the south shore of the park, steep bluffs rise abruptly from sea level to elevations of 30 to 80 ft amsl above narrow, rock-strewn beaches. The topography of Camp Hero is shown on **Figure 3-3**.

The geology of the Camp Hero State Park area is underlain by crystalline bedrock of Pre-Cambrian age. The bedrock consists of gneiss and schist and is estimated to be 1,300 ft below sea level inferred from bedrock boreholes on the North Fork of Long Island. Successive overlying units include unconsolidated deposits of Cretaceous, Pleistocene, and beach and marsh deposits of recent geologic age.

The Pleistocene deposits underneath Camp Hero are the result of the advance and retreat of several glaciers during the Pleistocene Epoch. These glacial deposits can be divided into two general categories by depositional environment: till (unstratified deposits) and stratified deposits. Till is a poorly sorted mixture of gravel, sand, silt, and clay deposited directly from the glacier by melting ice. Stratified deposits consist of the same till components, but are sorted into discrete beds by the action of flowing glacial meltwater [United States Geological Survey (USGS) 1986].

The upper 200 ft of these glacial deposits at Camp Hero can be broadly divided into an upper unit, consisting of undifferentiated (mixed) till and stratified deposits, and a lower unit of stratified deposits (USGS 1963). Within the upper unit, the lower 20 to 40 ft consists of interbedded clay, silt, and thin lenses of fine brown clay. The middle portion is compact clayey and gravelly till, occasionally grading laterally into fine-grained stratified sand deposits. Overlying the compact till, is typically stratified deposits 0 to 30 ft thick below the ground surface, composed mostly of lenses of silt, fine to medium sand, and clayey sand (USGS 1963).

As interpreted from a series of geophysical logs, the bottom of the upper undifferentiated till and stratified unit is mapped at 20 to 30 ft below sea level across Camp Hero and acts as a confining layer to the stratified sand units below (USGS 1986). The thickness of the upper undifferentiated till and stratified unit is greater than 100 ft, and the lower confining layer of this unit is continuous across the Camp Hero area. The location of regional USGS geologic cross sections of the Montauk Point area are shown on **Figure 3-5**, and the associated regional cross sections are presented on **Figure 3-6** and **Figure 3-7**. From the RI site-specific perspective, the location of additional site-specific geologic cross sections across the Camp Hero DUs are shown on **Figure 3-8**, and the associated site-specific cross sections are presented on **Figure 3-9** through **Figure 3-19**.

3.4 Hydrology and Hydrogeology

3.4.1 Hydrology

The surface water features of eastern Long Island include lakes, ponds, streams, and wetland areas. Many of these features occupy depressions referred to as kettle holes formed by retreating glaciers. The major lakes in the area include Fresh Pond, Fort Pond, Big Reed Pond, Little Reed Pond, and Lake Montauk. Oyster Pond is the lake closest to Camp Hero, which is located approximately 2,000 ft northwest of Camp Hero (see **Figure 3-2**).

In the Camp Hero area, the average quantity of precipitation is almost the same during the cool season (October–March) as during the warm season (April–September). However, precipitation is more frequent in the spring than in the fall. The long-term yearly average precipitation at Camp Hero is 44 inches per year.

According to the USGS, the amount of overland runoff from precipitation in Suffolk County is low because the majority of surficial materials are primarily stratified sandy deposits, which are highly permeable. However, the Camp Hero area has greater topographic relief and can have lower permeability of surface deposits (where unstratified till deposits are present at or near the surface). As a result, direct runoff in the Camp Hero area likely forms a greater percentage of total stream flow than elsewhere in Suffolk County. Unlike most of Long Islands streams further west, streamflow in the Camp Hero area remains high for several days after a storm because the precipitation, unable to percolate rapidly downward through till in the subsurface, moves laterally through the soil and discharges to stream channels (USGS 1986).

In addition, many of the narrow shallow drainage channels throughout the park have been enhanced and channelized with wooden revetments emplaced along the sides of the channels. The revetments were installed during the use of Camp Hero as a military installation to improve drainage from saturated areas across the facility. Approximately 14,000 ft of wooden revetments were installed in existing and man-made drainage channels throughout Camp Hero during that time, based on approximation using Geographic Information System data during this RI. No information was available on the methodology for installation of the revetments, but based on the approximate timeframe, it possible that the revetments were treated with creosote, which contained PAHs. Due to the channelization of the narrow streams, a large quantity of surface water drains from large areas of Camp Hero through the revetted stream channels during and after storms. The large amounts of surface water directed through the man-made channels discharge horizontally to the soils surrounding these channels and into downstream wetlands and ponds during and after storm events.

Under natural conditions, the streams and wetlands at Camp Hero receive freshwater primarily from groundwater discharge and, to a lesser extent, precipitation. Some of the wetlands contain water most of the year because they are underlain by deposits of low permeability till, which inhibit infiltration. Although small amounts of water leave these marshes by percolating through the till, most water leaves by evapotranspiration (USGS 1986). From April to September, when precipitation is less frequent and evapotranspiration is highest, most drainage features at Camp Hero become dry, and very little perched groundwater is available for recharge or may be locally absent.

Surface water flow at Camp Hero is influenced by a divide in the hydrographic basins. The divide generally runs north to south through the middle of the site. Surface water flows generally west from the divide in the western portion of the park and east, and southeast from the divide in the eastern portion of the park (**Figure 3-2**). The surface water flow from Camp Hero occurs primarily through three small unnamed streams. Two of the streams flow from the western portion of Camp Hero northwestward to Oyster Pond; the third stream flows north to south across the eastern portion of Camp Hero, collecting surface water from east and southeast flowing channels, and discharges to the Atlantic Ocean at the southern park boundary. **Figure 3-2** shows the extent of surface water drainage features and direction of surface water flow at Camp Hero.

3.4.2 Hydrogeology

The regional aquifer system in Suffolk County consists of a sequence of unconsolidated deposits overlying crystalline bedrock. The hydrogeologic units, in descending order, are: Pleistocene-aged glacial deposits that form the glacial aquifer, the underlying Gardiners Clay, the Cretaceous-aged deposits that compose the Magothy aquifer, the underlying Raritan Clay, and the Lloyd aquifer.

At Camp Hero, the glacial aquifer is present in the lower unit of stratified glacial deposits underneath the upper confining unit of undifferentiated till and stratified glacial deposits. The glacial aquifer has been classified as a confined freshwater lens hydrogeologic setting (USGS 1997). This classification represents areas in Suffolk County where the glacial aquifer is confined and bounded laterally and below by saltwater. The glacial aquifer is isolated from the rest of Long Island's groundwater system. The confined fresh water lens is under artesian pressure and has a head ranging from about sea level to 3.5 ft above sea level (USGS 1997).

The USGS conducted a study of the confined freshwater lens at Camp Hero in 1963. Thirteen observation wells were installed ranging in depth from about 70 to 150 ft. The location of the 1963 observation wells and geologic cross sections is shown on **Figure 3-5**. The location of the observation wells and geologic cross sections in relation to current site features and RI DUs are shown on **Figure 3-6.** The geologic cross sections are shown on **Figure 3-7.**

Groundwater in the confined freshwater lens flows horizontally at Camp Hero and discharges to Oyster Pond or the Atlantic Ocean (**Figure 3-7**). A USGS map of the depth of the confined freshwater lens and direction of flow in the Camp Hero area is provided as Figure 2 and Figure 3 in the Groundwater Potability Analysis of the perched groundwater, included in **Appendix K**.

Perched groundwater lenses are located in the upper till and stratified deposits above confining silt and clay. The perched groundwater lenses are the focus of the RI groundwater investigation. The perched water flows horizontally with the slope of topography and seeps into downgradient streams, drainage swales, and wetlands. These downgradient drainage features eventually flow off-site to Oyster Pond in the northwest and to the Atlantic Ocean to south. A map of the perched groundwater flow direction at Camp Hero is provided as Figure 1 in **Appendix K**.

Groundwater monitoring wells were installed into the perched groundwater zones at Camp Hero during the December 2016 Phase II and the June 2017 Phase III RI activities. A sitewide network of 43 monitoring wells was installed. The total depth of each monitoring well ranged from 15 to 40 ft bgs. The depth to groundwater in each monitoring well was measured during the RI and ranged from 6 to 28 ft bgs. Monitoring well construction information and additional details are in **Table 3-1**, and the sitewide groundwater monitoring well network is illustrated on **Figure 3-4**.

Based on monitoring well development and low-flow groundwater sampling RI activities, the perched groundwater exhibits low yields and is very slow to recharge. During the summer months, when precipitation is less frequent and evapotranspiration is highest, perched water may be locally absent at Camp Hero.

The perched groundwater elevations measured at DU monitoring wells range from 35 to 95 ft above the confined freshwater lens (**Figure 3-3**). For example, perched groundwater measured at monitoring well CH-MW013 (32 ft deep) was 48.85 ft amsl, whereas the groundwater elevation measured on the same day of the confined freshwater lens at existing nearby USGS Test Well (S19494), shown on **Figure 3-6**, was 3 ft amsl, a groundwater head difference of approximately 45 ft. The difference in groundwater elevations observed during the RI and reported in the 1963 USGS study supports perched water conditions.

A groundwater potability analysis was completed as part of this RI to assess whether perched groundwater at Camp Hero should be considered a potential potable water source. The results of this analysis indicate that the shallow perched groundwater at Camp Hero is unsuitable for drinking based on the perched groundwater characteristics and Suffolk County drinking water well standards. The Groundwater Potability Assessment is provided in **Appendix K**.

3.5 Habitat and Biota

The habitat information for each DU collected during the habitat survey is provided in **Table 3-5**. Although the habitat information was collected on an AOC-by-AOC basis prior to the designation of DUs, information from the applicable AOCs has been integrated into the description of each DU.

The land within Camp Hero has been relatively protected from residential development, agricultural practices, and tourist industries that currently dominate the developed portions of the Montauk Peninsula. As such, Camp Hero State Park can be considered refugia for a variety of plants and wildlife, including protected plant and animal species. While four New York State rarities have historically been recorded in the vicinity of Camp Hero, one in particular, the southern arrowwood (*Viburnum dentatum var. venosum*), was encountered frequently enough in mixed hardwood forests (during the habitat survey from November to December 2016) to be noted as a co-dominant shrub species.

Camp Hero's history as a former military installation and current status as a State Park has resulted in mixed land uses, and the amount of time since disturbance and degree of maintenance, continues to differentiate habitats on-site. The Nature Conservancy recognizes 35 communities within the Montauk Peninsula (The Nature Conservancy 2018). **Figure 3-20** depicts habitats of the Montauk Peninsula within Camp Hero State Park. Habitats observed on-site were generally consistent with the mapping depicted on **Figure 3-20**. However, the map mainly depicts the less disturbed natural communities and does not provide a land-use type for the more frequently maintained or disturbed areas of the park.

3.5.1 Highly Disturbed Habitat

Areas most frequently disturbed by Camp Hero State Park officials are those maintained as turf dominated by grasses in the *Poaceae* family*,* plantain (*Plantago* spp.), clover (*Trifolium* spp.), hawkweed (*Hieracium* spp.), hairy cat's ear (*Hypochaeris radicata*), and Virginia strawberry (*Fragaria virginiana*). Areas maintained through mowing at a less frequent interval are typically exposed to increased light by adjacent disturbance such as activity on roads and building paths, or tree-clearing activities. The increased light penetration and disturbance regime supports successional mesic grasslands dominated by little bluestem (*Schizachyrium scoparium*), switch grass (*Panicum virgatum*), flat-top goldentop (*Euthamia graminifolia*), and common wormwood (*Artemisia vulgaris*). Visitors are most likely to participate in activities in areas of managed turfgrass and less likely to push through mesic grasslands due to their brushy, tall nature when mature. Mesic grasslands areas could be relatively easily converted to maintained turf compared to other land-use types. Areas in the park that encourage visitor use by the inclusion of parking spaces, picnic tables, and grills are most often managed turf landscapes. Animals observed in mowed grass or mesic grasslands included songbirds and squirrels. There is also evidence of deer-browsing.

Prior building sites are comprised of a combination of building relics, concrete, blacktop, gravel, debris, and compact soils, creating an edge effect where invasive species are especially common. Invasive vegetation is typified by: bittersweet (*Celastrus orbiculatus*), privet (*Ligustrum* spp.), autumn olive (*Elaeagnus umbellate*), multiflora rose (*Rosa multiflora*), Japanese honey suckle (*Lonicera japonica*), Morrow's honeysuckle (*L. morrowii*), garlic mustard (*Alliaria petiolate*), common reed (*Phragmites australis* ssp.), and Japanese barberry (*Berberis thunbergii*). The prior building sites and adjacent ecotones are densely vegetated due to the growth habits of these invasive species, and fencing is placed to discourage visitors. While berries from privet, Japanese barberry, and other invasive plants are often favored by songbirds, the berries do not support the diversity of wildlife often seen in habitats with less invasive species coverage. Invasive species cause massive disruptions in ecosystem function, reduce biodiversity, and degrade ecosystem health.

3.5.2 Streams and Wetlands

While future development and disturbance of streams and wetlands within Camp Hero State Park are expected to be minimal, some streams show evidence of historical disturbance through revetments and therefore channelization. Typically, because straightened or channelized streams dissipate less energy and are more prone to erosion, they become more entrenched and can begin to widen and deepen as they increase sediment load to receiving streams (Brooker 1985). If entrenchment becomes severe enough, a stream can sever its connection to the adjacent floodplain, which causes changes to the ecosystem (USGS 2014).

Streams within Camp Hero can be divided into two main drainages. The streams in the western drainage are tributaries to an east-west stream (protected, Class C stream per NYSDEC Environmental Resource Mapper; NYSDEC 2018) within Camp Hero State Park that empties off-site into Oyster Pond. Streams in the eastern drainage are tributaries to a north-south stream within Camp Hero that empties off-site into the Atlantic Ocean. While downstream receiving bodies are noted in a regional context due to their ecological significance and relationship to on-site streams, they are outside of the study area and an ecological inventory and receptor studies were not performed.

Streams within Camp Hero State Park are categorized on **Figure 3-2** as intermittent streams or primary drainages; **Figure 3-2** also differentiates revetted streams from non-revetted streams. Select stream segments were characterized near DUs. The primary drainages within Camp Hero were generally second-order streams. Streams ranged from less than 1 ft in width to a maximum of approximately 10 ft in width, with water depths ranging from 0 ft (dry conditions) to approximately 1 ft deep. Stream flow in primary drainages and intermittent streams varied from no apparent flow to approximately 2 ft per second. Sparse vegetation, primarily skunk cabbage (*Symplocarpus* *foetidus*) and jewelweed (*Impatiens capensis*), was associated with the banks. In-stream substrate in primary streams was generally comprised of sand, silt, and clay with some streams also containing gravel. Low gradient streams are also noted on **Figure 3-2**. Low gradient streams generally had low to no flow, wetland vegetation inside the stream channel, no observed in-stream biota, and silt and organics (leaves) comprising the stream substrate. Soils in stream beds were typically hydric, indicative of reducing conditions. Benthic macroinvertebrates including Amphipoda (scud) and Trichoptera (caddisfly) were observed in the primary drainages and intermittent streams, but a detailed aquatic biology survey was not conducted.

Wetland habitat noted on **Figure 3-2** is based on the NYSDEC Environmental Resource Mapper wetland layer (NYSDEC 2018). A wetland assessment was performed for each DU due to the potential for DUs to overlap with wetland habitats or wetland buffers (as shown on **Figure 2-4**), and the potential for land-disturbance (including drilling) and tree-clearing. Generally, the site-specific wetland conditions within DUs were consistent with the state-mapped wetlands. However, this resource is primarily generated from desktop resources which typically lack the resolution to assess field conditions on a site-specific basis. The flagged wetland boundary within decision units typically included the state-identified wetlands and extended uphill to form a more inclusive wetland boundary. Wetlands were located in lower topography areas and generally associated with drainage features forming wetland-stream complexes. Forested wetland vegetation was typified by: red maple (*Acer rubrum)* in the tree stratum; northern spicebush (*Lindera benzoin*), highbush blueberry (*Vaccinium corymbosum*), and coastal sweetpepperbush (*Clethra alnifolia*) in the shrub stratum; and skunk cabbage (*Symplocarpus foetidus*) herbaceous layer. Mesic to moist shrub thickets were dominated by highbush blueberry*,* northern spicebush*,* and American black elderberry (*Sambucus canadensis*). Wetlands outside of DUs were not evaluated.

Recreational use by Camp Hero State Park visitors in wetlands is limited. Walking trails in forests often cross streams at areas of minimal fringe wetlands to minimize bridge span length. Furthermore, despite the function and value of wetlands, visitors are likely to avoid them due to their soggy and sometimes perceived smelly character. Wetland shrub thickets are exceptionally dense and also likely to deter visitor use. Wildlife usage was generally noted throughout Camp Hero State Park and wetland-specific fauna observations were not noted. However, it could be reasonably assumed that wildlife observed throughout Camp Hero State Park would pass through drainage corridors for water or while generally traversing across the landscape. Wildlife directly or indirectly observed during the November–December 2016 habitat surveys included Eastern wild turkey (*Meleagris gallopavo silvestris*), Eastern grey squirrel (*Sciurus carolinensis*), species of state-concern Eastern box turtle (*Terrapene carolina carolina*), various songbirds, and salamanders. A comprehensive wildlife survey was not completed during this RI and as such, this list contains the most likely species, but may not be complete.

3.5.3 Forests

Visitor walking trails frequently pass through dry to mesic mixed hardwood forests dominated by black oak (*Quercus velutina*) and white oak (*Q. alba*) and, to a lesser extent, red maple, sassafras (*Sassafras albidum*), black cherry (*Prunus serotine*), American basswood (*Tilia americana*), and mockernut hickory (*Carya tomentosa*). Common shrubs include American holly (*Ilex opaca*), Canadian serviceberry (*Amelanchier Canadensis*), mountain laurel (*Kalmia latifolia*), highbush blueberry (*Vaccinium corymbosum)*, and American witch hazel (*Hamamelis virginiana*). The tree and shrub species found in the dry to mesic mixed hardwood have potential value to park visitors and wildlife due to their mast production. More mature mixed hardwood forests are more easily traversed, and visitors may be more likely to venture off-trail as this habitat type can be more inviting than swamps or shrub thickets.

As indicated above, a comprehensive wildlife survey was not completed at Camp Hero. Terrestrial species most likely to occur at the site are habitat generalists tolerant of development, including the white-tailed deer (*Odocoileus virginianus*), Eastern gray squirrel, eastern cottontail (*Sylvilagus foridanus*), raccoon (*Procyon lotor*), little brown bat (*Myotis lucifugus*), white-footed mouse (*Peromyscus leucopus*), Eastern wild turkey, and various songbirds.

4.0 NATURE AND EXTENT OF CONTAMINATION

Section 4.0 summarizes the soil, sediment, surface water, and groundwater analytical data obtained during environmental investigations and used for evaluation of the potential human health and ecological risks at Camp Hero. Figures are provided in **Appendix A**, the tables referenced in this section are provided in **Appendix B1**, and tables of all analytical results are provided in **Appendix B2**.

Section 4.1 provides an overview, CSM discussion, and a summary of physical characteristics, current uses, geology, hydrogeology, ecological habitat, nature and extent of contamination, and potential risks for each individual DU. As the AOCs within the DUs represent the potential sources of contamination, the individual DU discussions also consider potential chemical migration and risks in other media, which are discussed in more detail in Section 4.2 (surface water and sediment) and Section 4.3 (sitewide groundwater).

This risk assessments conducted as part of this RI were used to identify which chemicals were the focus the nature and extent of contamination discussion. Specific chemicals that contributed most to potential risks are discussed in more detail. The results of the HHRA and the ERA are summarized in Section 6.0, and the full evaluations are presented in **Appendix M** and **Appendix N**, respectively.

As further described in Section 6.0, the preliminary risk screening step included comparisons of maximum detected concentrations of chemicals against applicable human health or ecological screening levels and BTVs (the ERA also included screening level food web models). Chemicals that exceeded the BTVs and the applicable screening levels (or that identified a potential risk in the food web model) were subject to background hypothesis testing to determine whether site concentrations were consistent with background concentrations. If metals were not consistent with background concentrations, they were also subject to a geochemical evaluation to assess whether they were expected to be naturally occurring. Chemicals that exceeded BTVs and the applicable human health or ecological screening levels (or that identified a potential risk in the food web model), and were not deemed to be consistent with background conditions or with naturally occurring metals, were identified as final COPCs for evaluation in the HHRA and/or the ERA. COPCs within each media in each DU or SEA were quantitatively evaluated within the HHRA and ERA. Chemicals that resulted in potentially unacceptable risks were further evaluated in the uncertainty assessment portion of the HHRA and ERA. This further evaluation included reviewing the spatial distribution of total PAHs (as discussed below), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs (**Appendix C5**).

The nature and extent of contamination are based on the data collected during the three phases of investigations. In general, sufficient analytical data was obtained to complete the nature and extent for metals, VOCs, SVOCs, and PCBs. Hexavalent chromium was not analyzed in all samples; however, as described in **Appendix C2**, hexavalent chromium concentrations were estimated from total chromium concentrations when analytical results were not available. The RI and risk assessments include the measured and estimated hexavalent chromium data values together. However, the data tables in **Appendix B2** present the differentiated values.. When hexavalent chromium was analyzed, the analytical laboratory reported trivalent chromium as the difference between total chromium and hexavalent chromium. As trivalent chromium is not truly measured, these results are presented in **Appendix B2** but are not evaluated quantitatively in the RI or risk assessments.

PAHs and PCBs were analyzed and evaluated as individual PAHs and aroclors, respectively. In addition, for use in the risk assessments, several totals were also calculated, including: total PCBs, total PAHs, total high molecular weight (HMW) PAHs, total low molecular weight (LMW) PAHs, and total benzo(a)pyrene (BaP) equivalent PAHs (referred to as total BaP PAHs). The approach for calculating these totals is provided in **Appendix C1**.

4.1 Decision Units

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from the Camp Hero AOCs. The sampling design consisted of biased sampling to target potential source areas and included the collection of surface soil, subsurface soil, and grab groundwater samples. Refer to the Phase I Investigation Field Report (**Appendix E**) for additional details on the Phase I field investigation, including figures of the Phase I sampling locations. Refer to **Appendix B2** for the full analytical results from all phases of investigation.

The Phase II RI field investigation focused on the former Building 203 AOC (now DU01) due to the discovery of LNAPL at that AOC during the Phase I effort. The sampling design included the collection of unbiased surface soil samples, biased subsurface soil samples, and groundwater samples from permanent monitoring wells. Refer to the Phase II Investigation Field Report (**Appendix F**) for additional details on the Phase II field investigation, including figures of the Phase II sampling locations.

As described in Section 2.4.1, a PSE of the existing dataset was conducted after the Phase I and II field investigations to identify additional data needs for the Phase III RI field investigation. Results of the PSE are presented in **Appendix G**. The AOCs warranting additional sampling were grouped into 18 geometric DUs as uniform 0.5- or 1-acre geometric exposure areas encompassing potentially impacted soil.

The Phase III investigation was designed to collect an unbiased, representative dataset for potentially impacted media for each DU. Within each DU boundary, surface soil samples were collected from 0 to 1 ft bgs from an unbiased grid of 16 samples. At the nine DUs warranting additional subsurface soil sampling based on the PSE, subsurface soil samples were collected from 1 to 10 ft bgs (or 1 to 2 ft bgs in wetland boundaries or wetland buffer zones) at the same locations as surface soil, with the exception of DU01, where the unbiased grid of subsurface soil samples was not co-located with surface soil samples because they were collected in two separate phases. The entire subsurface depth horizon was composited for laboratory analysis. Parameter groups for soil included VOCs, SVOCs, PCBs, and metals (including mercury in all samples and hexavalent chromium in 10% of samples), depending on the CSM for each DU. Because energetics (munitions) were not detected in any of the Phase I samples, no additional sampling for energetics was performed. If planned sampling locations were inaccessible during the Phase III field effort, the sampling locations were adjusted as necessary to ensure collection of the minimum required set of samples. Refer to the Phase III Investigation Field Report (**Appendix H**) for additional details on the Phase III field investigation.

The following subsections briefly summarize the DU-specific soil sampling activities completed for each phase of the field effort. The Phase III dataset obtained for each DU may also include nearby groundwater, surface water, and sediment, depending on the CSM for each DU. Surface water and sediment samples were collected from SEAs within or downgradient from the DUs to assess impacts from the DU, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of the DUs was assessed as part of the sitewide network of groundwater monitoring wells, as well as on a well-by-well and DU-by-DU basis. Surface water, sediment, and groundwater relative to each DU are included in the DU-specific discussions below. The complete details for each SEA and sitewide groundwater are discussed in Section 4.2 and Section 4.3, respectively.

4.1.1 DU01: Former Building 203

4.1.1.1 Overview and Historical CSM

DU01 is a 1.0-acre DU established to assess potential impacts from former Building 203 and associated USTs (AOC 203). The location of this DU within Camp Hero is illustrated on **Figure 2-4**, and site-specific detail on **Figure 4-1a**. Potential impacts at DU01 were identified based on the historical use of former Building 203 as an electrical power generating plant, the presence of former USTs, a 1993 NYSDEC Spill Report (Case Number 93-09575) that documented a petroleum release at the USTs, and remedial and site assessment activities conducted in 1994 to 1995 in response to the release.

In 1949, approximately 97 acres of former Camp Hero, including DU01, was transferred to the Department of the Air Force for an aircraft control and warning station. In 1952, the Air Force property was renamed the Montauk Air Force Station and used by the Aircraft Control and Warning Squadron. The radar surveillance facility was expanded to include the Radar Tower, Antenna, and electrical power supply (former Building 203) by 1960. The electrical power was supplied by four diesel generators within former Building 203. The diesel fuel was supplied to the generators by UST 16 (25,000 gallon capacity) and UST 18 (25,000 gallon capacity) located approximately 25 ft southwest of former Building 203. Lubricating oil for the generators was supplied from UST 17 (1,000 gallon capacity) located at the southeast side of the building. The archive site plans also indicate several petroleum ASTs associated with the generators operation were located inside the southwest wall of Building 203.

Building 203 archive drawings indicate that the former fuel pump house and former 200,000 gallon diesel fuel AST (AST-35), located northwest of DU01, also supplied diesel fuel through a fuel line extending from the former AST-35 location to the former diesel USTs at Building 203. Four former industrial-sized radiators (one for each generator) were located southwest of the former Building 203 to circulate radiator fluid for cooling each generator. **Figure 4-1a** shows the location of the historical site features for DU01.

Between 1974 and 1984, site lands were transferred to the state of New York, and the facility was permanently closed in 1982. In 1993, UST 16, UST 18, and UST 17 were removed from the perimeter of former Building 203. Upon removal of USTs 16 and 18, a petroleum sheen and green liquid that appeared to be ethylene glycol was observed on the sidewalls of the excavation and on water standing in the bottom of the excavation at 17 ft bgs. A solvent odor was present and it was suspected that solvents had been dumped around the southwest side of former Building 203, based on visual evidence of surface soil staining and elevated volatile and semivolatile laboratory results of soil. The soils surrounding the UST 17 excavation were also observed to contain lubricating oil. The field observations recorded in the UST Closure Report for USTs 16 and 18 indicated that the majority of the diesel fuel feed and return lines, located 2 ft bgs, were leaking at their pipe joints. The USTs 16 and 18 appeared to be in good condition, which was confirmed upon demolition and cleaning (Gold Seal Corporation 1994).

The removal of petroleum-impacted soil was conducted on two separate occasions, upon UST removal in 1993 and in the spring of 1994. A total of 2,500 cubic yards (cy) of soil were removed at the single over-excavated pit for USTs 16 and 18 in 1993, and 50 cy of soil were removed at UST 17 excavation in 1994. Petroleum-impacted soil was also removed from the northwest side of the building to a depth of 10 ft bgs and the southwest side of the building to a depth of 5 ft bgs, from Building 203 to the edge of the UST 16 and 18 pit excavation. Further excavation of petroleum-impacted soil observed on the excavation sidewalls of the USTs 16 and 18 was discontinued until a site assessment could be conducted to determine the extent of the remaining petroleum-impacted soil. According to the UST closure report, the slope of the excavation sidewalls was reduced by pushing soil into the pit to reduce safety hazards at the site, potentially allowing petroleum-impacted soil to enter the excavation area. The former Building 203 was demolished to 2 ft bgs and debris was moved offsite by September 1994 (Gold Seal Corporation 1994).

A Site Assessment Report was submitted for the site to NYSDEC in June 1995. Nine GeoProbe® borings were conducted surrounding the USTs excavation and two GeoProbe® locations were conducted near the center of the open excavation. A soil sample was collected from each boring surrounding the excavation at depths ranging from 12 to 19 ft bgs. Soil was sampled at the GeoProbe® location near the center of the excavation at 53 ft bgs. Dense clay was found at depth and surrounding the UST excavation. A temporary well was installed to 21 ft bgs near the center of the excavation, which slowly recharged with groundwater overnight. Soil and groundwater samples were analyzed for the NYSDEC STARS analytical list. The results of all soil and groundwater samples taken were below screening criteria (Tyree Brothers Environmental Services, Inc. 1995). The Spill Report Case was closed by the NYSDEC in July 1995 and the excavation was backfilled (NYSDEC Spill Report Case Number 93-09575 in 1993). However, based on the RI conclusions, the soil borings conducted around the UST excavation during the 1994 site assessment may have been too shallow to detect heavily petroleum-impacted soil beneath the former USTs.

The Phase I RI field investigation assessed VOCs, SVOCs, PCBs, and metals in surface and shallow subsurface soil at the former Building 203 AOC. Additionally, approximately 5.30 ft of LNAPL was discovered in piezometer PZ-3 near the western edge of the former UST excavation. A petroleum release was reported by USACE on 19 June 2016, and Pollution Complaint Number PC-1602757 was assigned to the case.

The Phase II RI field investigation at the former Building 203 AOC focused on defining the nature and extent of the LNAPL identified during Phase I, as well as the collection of additional surface soil, subsurface soil, and groundwater samples. Parameter groups included VOCs, SVOCs, and metals (including mercury and hexavalent chromium). Because PCBs were not detected in any of the Phase I samples, no additional sampling of PCBs was performed. Details of each phase of field investigation are presented in Section 4.1.1.3 below and in the Phase I, Phase II, and Phase III Investigation Field Reports (**Appendix E**, **Appendix F**, and **Appendix H**).

A PSE of the existing dataset was conducted after the Phase I and II field investigations to determine additional data needs during the Phase III RI field investigation, after which the former Building 203 area was established as DU01. The DU01 site boundary encompasses the area of petroleum-related impacts at former Building 203. Based on the PSE, additional samples for VOCs, SVOCs, and metals in subsurface soil and groundwater were warranted for DU01. Therefore, unbiased sampling for these parameters in subsurface soil was completed during the Phase III RI field investigation. The Phase II and III datasets obtained for DU01 include surface soil, subsurface soil, and groundwater, as well as nearby surface water and sediment. Although no streams directly transect this DU, surface water and sediment samples were collected from a downgradient stream (represented by locations within SEA06). Those samples were collected to assess potential impacts from DU01, DU02, and DU03, as well as support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of this area, specifically from CH-MW016 through CH-MW025, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.1.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU01.

Description and Current Use

DU01 is located in the southwestern portion of Camp Hero. The topography of DU01 is relatively flat in the southeastern and central portions of the DU, then is steeply sloped from southeast to northwest in the northern and eastern portions of the DU. The DU is bounded on the northeastern edge by a fence for the Radar Tower. Further downslope to the west is an adjacent study area, DU02, and eventually a non-revetted stream channel (characterized by SEA06), located to the north and west of DU02. Land cover is wooded along the north, west, and south borders of the DU, while the central portion of the DU is a park-maintained lawn. NYSDEC Class 2 mapped wetlands are shown along the western portion of DU01; however, wetlands were not observed within the DU01 boundary during the Phase III field investigation. Wetlands were observed downgradient within DU02 and along SEA06. The central portion of the DU contains a paved access road and landscaped areas surrounding the footprints of former buildings and structures, which include former Building 203, a series of four commercial radiators, and former locations of USTs. Other than site access via the existing road and entrance gate in the southeast, this area has relatively limited access because of the wetlands and steep terrain. No plans for development or future use are proposed, other than the continued maintenance of the Radar Tower security fencing.

Geology

The geology of DU01 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-9** depicts the geologic cross section of DU01 from north to south and **Figure 3-10** depicts the geologic cross section of DU01 from east to west). Numerous subsurface soil borings were advanced within DU01, and seven monitoring wells were installed within the immediate vicinity of DU01 (CH-MW016 though CH-MW022). Three additional nearby wells, CH-MW023 through CH-MW025, were included in the DU01 groundwater evaluation during the HHRA, but those wells are not included in this discussion of DU01-specfic geology and hydrogeology. Soil cuttings logged from boreholes consisted of silty/clayey sand with interspersed layers of fine to medium sand. Altering layers of lean/fat clay and fine sand were observed in all of the monitoring well borings (CH-MW016 through CH-MW022) from approximately 15 to 30 ft bgs. The thickness of these layers varied in each borehole. Moist to wet soils were confined to the fine sand and silty sand layers; although there was no clear presence of a continuous perched aquifer unit, perched water was present in the subsurface in discontinuous lenses.

Hydrogeology and Groundwater Conditions

As discussed in Section 3.4.2, the shallow groundwater encountered at DU01 consists of perched groundwater lenses located in the upper till and stratified deposits above approximately 80 feet of confining silt and clay that separates the perched groundwater lenses and the confined freshwater lens. LNAPL in DU01 exists in the perched groundwater zone in the upper till and stratified deposits, which consists of silty/clayey sand with interspersed layers of fine to medium sand. Altering layers of lean/fat clay and fine sand with varied thicknesses were observed in all of the monitoring well borings.

Gauging of the perched groundwater was performed on 23 and 28 June 2017. Groundwater elevations ranged from 55.02 ft amsl at CH-MW018 to 89.40 ft amsl at CH-MW020. Groundwater contours are shown on **Figure 3-3**. Groundwater flows west and south, generally following the topographic relief of DU01 with an approximate horizontal hydraulic gradient (measured parallel to groundwater flow) across DU01 of 0.145.

Hydraulic Conductivity: Perched Groundwater

To characterize hydraulic conductivity of the perched water-bearing soils at the site, slug testing was completed at five monitoring wells at DU01 (CH-MW016, CH-MW018, CH-MW019, CH-MW020, and CH-MW021). All the wells were screened in undifferentiated deposits of till and stratified drift. The procedures and details of the slug testing are provided in the Hydraulic Conductivity Analysis (**Appendix J**).

The hydraulic conductivity results of multiple slug tests at each of the five test wells at DU01 were consistent for each well analyzed. This demonstrates the hydraulic response was repeatable at each well and representative of the hydraulic conductivity at that well location. However, the slug test analysis results show that the hydraulic conductivity was variable and ranged at well locations on a sitewide basis from 0.01 feet/day at CH-MW019 to 1.9 feet/day at CH-MW016.

This variability of the hydraulic conductivity values across the site is due to the presence and various thicknesses of interbedded layers of silty sand, silt, and clay layers in the undifferentiated till that contains the perched groundwater. In addition, some areas of the site soils have been reworked by previous development, including subsurface utilities and UST excavations. The reworking of soil alters native soil permeability and may affect local perched water flow at individual monitoring wells. The slug test analysis at DU01 indicates that while there may be localized variability in hydraulic conductivity in soils due to the heterogeneous environment, the soils within the perched water bearing zone across the site demonstrate moderate to low permeability.

Hydraulic Conductivity: Clay Confining Unit

Two subsurface soil core samples were collected at DU01 and submitted for geotechnical laboratory analysis of hydraulic conductivity following ASTM method D5084 (hydraulic conductivity of saturated porous materials using a flexible wall permeameter). The purpose of the soil core samples was to obtain representative analysis of the permeability of clay layers which are interbedded and underlie the perched water bearing zone. One soil core was collected from soil boring DU01-S009 at 15 to 17 ft bgs and one soil core was collected from soil boring DU01-S015 at 25 to 27 ft bgs. These soil core samples were taken from thick clay layers encountered at these two borings at DU01. Clay was encountered at soil boring DU01-S009 from 8.5 ft bgs to the total depth of the borehole at 17 ft bgs and at soil boring DU01-S015 from 8.5 feet bgs to the total depth of the borehole at 29 ft bgs. Thick clay layers were generally intercepted at shallow depths in the southeastern portion of the site and at greater depths to the southwest. The geotechnical laboratory reports on provided in Appendix H.

The results of the geotechnical laboratory analysis of hydraulic conductivity of the clay core samples were 3.9×10^{-8} cm/sec at DU01-S009 (15 to 17 ft bgs) and 2.0×10^{-7} cm/sec at DU01-S015 (25 to 27 ft bgs). The measurements are equivalent to 0.0001 ft/day to 0.0006 ft/day, respectively. The very low hydraulic conductivity results of the clay support the site observations of clay layers representing confining units within and underlying the perched water bearing zone.

Water quality conditions within monitoring wells in the immediate vicinity of DU01 (CH-MW016, CH-MW018, CH-MW019, CH-MW020, CH-MW021, and CH-MW022) were variable between monitoring wells, with aerobic conditions in some locations and anaerobic conditions in other locations (**Table 3-2**). DO concentrations ranged from 0.03 milligram per liter (mg/L) at CH-MW016 to 6.18 mg/L at CH-MW019 mg/L. ORP ranged from -149.1 millivolts (mV) at CH-MW041 to 256.9 mV at CH-MW019. All other field parameter data (temperature, specific conductance, and turbidity) were comparable to measurements observed in other monitoring wells across the site. Monitored natural attenuation (MNA) parameters were collected from CH-MW016 and CH-MW020 to support the evaluation of remedial alternatives. MNA parameters consisted of biochemical oxygen demand, total oxygen demand, total organic carbon, ferrous iron (field analysis), chlorides, sulfates and sulfides, nitrates and nitrites, alkalinity, methane, ethane, and ethene. MNA data are presented in **Table 3-3**.

Habitat and Ecological Setting

DU01 encompasses a 1-acre parcel which includes an open field, bound by steep inclines, woods, and a partial fence. Portions of the DU also include pavement and landscaped areas associated with former buildings and structures. These developed areas are unlikely to provide habitat for wildlife. A fence is present on both the east and west sides of the DU, but does not limit access to the DU by wildlife (e.g., deer). Evidence of deer was observed at the DU, and a box turtle was observed multiple times in the vicinity of CH-MW019. The successional field contains scattered shrub thickets dominated by autumn olive (*Elaeagnus umbellate*), little bluestem (*Schizachyrium scoparium*), switch grass (*Panicum virgatum*), and common flat-top goldenrod (*Euthamia graminifolia*). Multiflora rose (*Rosa multiflora*), highbush blueberry (*Vaccinium corymbosum*), and Japanese honeysuckle (*Lonicera japonica*) were also present within the DU, and southern arrowwood (*V. dentatum var. venosum*; a state threatened species) was observed within the boundaries of the DU.

Wetland conditions were not observed within the DU during the Phase III field effort, but palustrine forested wetlands are located downgradient to the southwest at DU02. Surface water drainage within DU01 is generally to the northwest and west.

4.1.1.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from residual petroleum and possible solvents at the former Building 203 (AOC 203), as described in the historical CSM for DU01 above. The sampling design consisted of biased sampling to target the area downgradient of the excavation of historical USTs 16 and 18. Parameter groups consisted of VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil and grab-groundwater.

Additionally, three piezometers (PZ-1 through PZ-3) were installed to help determine groundwater flow direction in the vicinity; analytical samples were not collected from these piezometers. Upon gauging, approximately 5.30 ft of LNAPL (8.00 ft to 13.30 ft bgs) were discovered in piezometer PZ-3. This new finding of a petroleum release was reported by USACE to the NYSDEC, and NYSDEC Pollution Complaint Number PC-1602757 assigned to the area. Refer to the Phase I Investigation Field Report (**Appendix E**) for more details on the Phase I field investigation, including figures of the Phase I sampling locations. Refer to **Appendix B2** for the full analytical results from all phases of investigation.

As a result of the petroleum impacts observed during Phase I, and specifically the presence of LNAPL, former Building 203 AOC was prioritized in the Phase II RI field investigation. The Phase II investigation was focused on refining the extent of LNAPL and consisted of high-resolution characterization using LIF Ultraviolet Optical Scanning Tool (UVOST)® screening, monitoring well installation and development, bail-down tests of LNAPL present in monitoring wells, fuel fingerprint analysis of the LNAPL in PZ-3, and the collection of surface soil, subsurface soil, and groundwater samples. Parameter groups included VOCs, SVOCs, and metals (including mercury and hexavalent chromium). Because PCBs were not detected in any of the Phase I samples, no additional sampling of PCBs was performed. During the risk assessment, 32 surface soil samples were collected from an unbiased grid for use in calculating EPCs. A total of 36 subsurface soil samples were collected from biased depths, which indicated potential petroleum impacts (via staining, olfactory indicators, or elevated photoionization detector [PID] readings) to further define the vertical and horizontal extent of LNAPL. Additionally, approximately 1.98 ft of LNAPL (25.54 ft to 27.52 ft bgs) were observed at CH-MW017 upon gauging; therefore, a groundwater sample was not collected from that location. Refer to the Phase II Investigation Field Report (**Appendix F**) for more details on the Phase II field investigation, including figures of the Phase II sampling locations.

A PSE of the existing dataset was conducted after the Phase I and II field investigations, after which the former Building 203 area was established as DU01. Based on the PSE, potential site impacts at DU01 were identified for VOCs, SVOCs, and metals in surface soil, subsurface soil, and groundwater. However, because an unbiased grid of surface soil samples was collected for surface soil during Phase II for use in the risk assessments, no further surface soil characterization was necessary during Phase III.

The Phase III investigation of DU01 was designed to establish an unbiased sampling grid for VOCs, SVOCs, and metals in subsurface soil. The Phase III program also included:

- Collection of nearby surface water and sediment samples for SVOCs and metals to assess potential downgradient impacts associated with DU01, as well as support the sitewide evaluation of surface water and sediment;
- Collection of two undisturbed subsurface soil samples by Shelby tube methodology for laboratory analysis of soil permeability at DU01;
- Installation and development of additional monitoring wells;
- Collection of in-situ hydraulic conductivity test data (via rising or falling head slug tests) at five permanent monitoring wells at DU01; and
- Collection of groundwater samples.

Refer to the Phase III Investigation Field Report (**Appendix H**) for additional details on the Phase III field investigation. **Exhibit 4-1** provides the progression of the field sampling implemented at DU01. Refer to **Appendix B2** for the full analytical results and **Figure 4-1b** for the sampling locations associated with the Phase II and Phase III field investigations at DU01.

Exhibit 4-1. DU01 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	--	*Quantity:* 9 (biased) *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 5 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3] *Note:* PCBs could only be collected at 3/5 locations	--	--
II	*Quantity:* 32 (unbiased) *Analyses:* VOCs[1], SVOCs[2], metals[4]	*Quantity:* 36 (biased) Analyses: VOCs[1], SVOCs[2], metals[4]	*Quantity:* 5 total & dissolved[5] *Analyses:* VOCs[1], SVOCs[2], metals[4]	--	--
III	--	*Quantity:* 16 (unbiased) *Analyses:* VOCs[6], SVOCs[7], metals[8]	*Quantity:* 9 total & dissolved[9] *Analyses:* VOCs[6], SVOCs[7], metals[8]; MNA[10] in 10%	**SEA06** *Quantity:* 14 total, 5 dissolved *Analyses:* SVOCs[7], metals[8], hardness	**SEA06** *Quantity:* 15 *Analyses:* SVOCs[7], TOC, metals[8]

Notes

1 Phase I and II VOCs included the full Target Compound List (TCL) for VOCs.

2 Phase I and II SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D Selected Ion Monitoring (SIM) to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase II metals included the full list of TAL metals including mercury and hexavalent chromium in 100% of samples. ORP and pH analysis were conducted by the laboratory for soil samples.

5 Phase II dissolved groundwater samples were collected for metals (including mercury and hexavalent chromium) only.

6 Phase III VOCs included selected TCL VOCs based on PSE results, plus the NYSDEC STARS list.

7 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

8 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

9 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

10 MNA parameters were analyzed in 10% of groundwater samples. MNA parameters consisted of biochemical oxygen demand, total oxygen demand, total organic carbon, ferrous iron (field analysis), chlorides, sulfates and sulfides, nitrates and nitrites, alkalinity, methane, ethane, and ethene.

On 19 September 2018, USACE team members gauged the DU01 wells which previously contained LNAPL, as well as one additional well (CH-MW016).LNAPL was measured in CH-MW016 for the first time since it was installed, which is not unexpected as LNAPL staining and elevated PID readings were recorded in the boring log. Approximately 0.42 ft of LNAPL (14.04 ft to 14.46 ft bgs) was observed at PZ-3, 3.02 ft (23.50 ft to 26.52 ft bgs) was observed at CH-MW017, and 0.02 ft (21.06 ft to 21.08 ft bgs) was observed at CH-MW016. These most recently LNAPL thickness measurements are reflected on **Figure 4-1c** and **Figure 4-1d**.

LNAPL

The following subsections describe the physical properties, spatial distribution, mobility and stability, recoverability, and potential for Natural Source Zone Depletion (NSZD) with respect to LNAPL at DU01. Refer to the Phase I, Phase II, and Phase III RI Investigation Field Reports (**Appendix E**, **Appendix F**, and **Appendix H**, respectively) for supporting documentation.

The Interstate Technology and Regulatory Council (ITRC) published a technical document that established descriptors for LNAPL including "residual" LNAPL, "mobile" LNAPL, and "migrating" LNAPL (ITRC 2018). These descriptors relay the potential for LNAPL movement within the subsurface. The terms are defined as follows:

- **Residual LNAPL** describes the condition where LNAPL is present as a discontinuous phase within soil pores; thus, residual LNAPL is immobile and functionally trapped in pore spaces. Residual LNAPL will not accumulate in a monitoring well because of its inability to flow (i.e., the LNAPL is at residual saturation).

- **Mobile LNAPL** describes the condition where LNAPL is present above residual saturation. Mobile LNAPL is capable of moving laterally and vertically within the existing LNAPL plume footprint. Mobile LNAPL will accumulate in a monitoring well. The NYSDEC definition of the commonly used term "free product" is consistent with the ITRC definition for mobile LNAPL.

- **Migrating LNAPL** describes the condition where LNAPL is able to move outside of the existing LNAPL plume footprint into a previously un-impacted area, thereby causing expansion of the LNAPL footprint. This condition is only possible when there is sufficient LNAPL head pressure present at the fringe of the LNAPL plume to displace other pore fluids (air and groundwater) from the soil pores. Migrating LNAPL is mobile LNAPL but not all mobile LNAPL is migrating LNAPL.

All LNAPL bodies eventually reach a stable or shrinking condition after a release and/or releases have been abated. The time to reach a stable configuration is dependent on a number of parameters, including LNAPL release history, aquifer matrix characteristics, and LNAPL physical properties, as well as the rate at which LNAPL is depleted through NSZD processes and/or engineered recovery systems.

Physical Properties of LNAPL

As noted above in Section 4.1.1.1, the suspected source of the LNAPL at DU01 is the former 25,000-gallon USTs removed in 1993. A LNAPL sample collected from PZ-3 on 3 December 2016 was submitted to ELLE for quantitative gas chromatography (GC) petroleum hydrocarbons fingerprinting and PCB content. No PCBs were detected in the sample. The GC fingerprint for the sample was most similar to the laboratory's Diesel/#2 Fuel Oil reference chromatogram, consistent with the suspected source. Differences in relative peak intensities and ratios indicated that the LNAPL is weathered. The laboratory calculated the total sample area in the C8-C40 normal hydrocarbon range as petroleum distillate and is present at 83% by weight.

Distribution of LNAPL

During the Phase II field investigation, high-resolution characterization of the LNAPL at former Building 203 was conducted using LIF UVOST® technology to characterize the extent of LNAPL and optimize monitoring well placement. LIF UVOST® is a high-resolution LNAPL mapping tool used to delineate the depth and horizontal extent of LNAPL. The extent of LNAPL impacts at the DU01 are relatively well-delineated based on LIF borings, observed in-well LNAPL accumulations, and dissolved-phase concentrations.

The LIF investigation initially focused on the location of piezometer PZ-3, where LNAPL was observed in Phase I, and then stepped outward as necessary in a grid-like pattern to delineate the extent of LNAPL. The LIF screening was conducted at 44 locations, as shown on **Figure 4-1d**, to a maximum depth of 40 ft bgs. The LIF logs are presented in **Appendix F**. LIF logs were not produced for four of 44 the locations (203OO, 203PP, 203TT, and 203YY) due to refusal at a shallow depth. The LNAPL plume could not be fully delineated to the west/northwest using the LIF UVOST® due to the presence of a steep grade preventing access of the Geoprobe® rig. However, monitoring wells were installed downgradient of this area to delineate LNAPL.

Visual inspection of the LIF logs was used to establish a site-specific background fluorescence response. UVOST® causes PAHs in LNAPL to fluoresce and this fluorescence is measures as the LIF response as percent reference emitter (RE). The RE is a non-aqueous phase liquid (NAPL) used to calibrate the LIF response. Ideally, the UVOST® would only respond to PAHs in NAPL, however minerals in soils may also fluoresce. The UVOST® measures fluorescence at four wavelengths, which produces a waveform. Professional judgement is used to differentiate a waveform response related to site LNAPL versus background conditions. LIF responses that are not consistent with a waveform from site LNAPL (or known LNAPL waveforms) are considered background. For example, location 203QQ had a maximum response of 3.7% RE, which was considered a background location based on the waveform and its location outside of the LNAPL-impacted area of the site. All borings were evaluated, and it was determined that LIF locations with maximum LIF responses below 7% RE were consistent with background conditions. LIF locations with LIF responses greater than the background level were considered indicative of LNAPL. Accordingly, a fluorescence response greater than 7% RE was used as an indication of LNAPL. The LIF response is generally correlated to the LNAPL saturation; however, the relationship can be complicated due to variations in soil types and degrees of weathering of the LNAPL. Therefore, the LIF response is used to delineate the presence of LNAPL in the formation.

Seven monitoring wells (CH-MW016 though CH-MW022) were installed within the immediate vicinity of DU01 during the Phase II and III field investigations. One was installed hydraulically upgradient, three were installed side-gradient, and three were installed downgradient of the LNAPL source area (**Figure 4-1c**). Three additional wells (CH-MW023 through CH-MW025) were installed further downgradient from DU01 to assess impacts from the former AST35 and FPH AOCs, as well as DU01.

Horizontal Distribution

The highest fluorescence responses (above 300% RE) were observed in areas around the former #2 fuel oil USTs. The maximum fluorescence observed at each LIF boring location and the measured LNAPL accumulations in monitoring wells are depicted on **Figure 4-1d**. The predominant groundwater gradient in the vicinity of the LNAPL is to the northwest, as shown on **Figure 4-1c**. Although LNAPL is present in CH-MW017 and CH-MW016, the monitoring wells CH-MW018 and CH-MW023 bound the horizontal extent of the LNAPL in the downgradient direction. Although LIF could not be conducted in the area of the former Building 203 foundation due to concrete refusal with the Geoprobe® drill rig, three soil borings (locations 203-SB33, 203-SB35, and 203-SB37) were advanced to 35 ft bgs in this area using a sonic drill rig; no LNAPL was encountered in any of the borings. The results show that areal delineation is complete at the site, as depicted by clean borings or monitoring wells in all directions of the site. The approximate aerial distribution of LNAPL is shown on **Figure 4-1d**.

Vertical Distribution

LIF responses were compared to the interpreted geology to evaluate the vertical distribution of LNAPL. The vertical distribution of LNAPL is presented on DU01-specific cross sections, **Figure 4-1e** and **Figure 4-1f**, which also present the LIF responses superimposed adjacent to corresponding borings. The transects for the DU01-specific cross sections are shown on **Figure 4-1c**. Results indicate that vertical delineation of LNAPL is complete, with all locations advanced beyond the bottom of the observed smear zone.

Examination of the LIF logs indicate there is a vertical smear zone, a vertical extent of LNAPL-affected soils, that extends on average between 9 and 22 ft bgs. The largest smear zone, 29 ft thick, was measured at 203EE, starting at 7 ft bgs and extending to 36 ft bgs. As shown on **Figure 4-1e** and **Figure 4-1f**, a majority of the LIF response is typically below the measured perched groundwater lenses. The large vertical smear zone that extends below the current perched water is indicative of periods of low water levels. Large groundwater fluctuations would be expected within perched groundwater lenses that are sourced from surface water infiltration. **Figure 4-1g** presents the CSM for DU01.

Mobility and Stability of LNAPL

As mentioned above, all LNAPL bodies eventually reach a stable or shrinking condition after a release and/or releases have been abated. There have been numerous advances in the understanding of LNAPL behavior in the subsurface in the past few decades. However, due to the complex interplay between parameters that control LNAPL migration, there is no single, stand-alone method for evaluating LNAPL stability at the field scale. Given the complexity of multi-phase fluid flow in porous and fractured media, LNAPL stability is typically evaluated using multiple, complimentary lines of evidence, where agreement between multiple methods builds confidence in the conclusion.

LNAPL from older releases are likely to be stable due to smearing/residualization of LNAPL, and depletion through remediation and/or NSZD processes. Additionally, numerical simulations for a large range of release conditions indicated that most LNAPL bodies stabilized within 3 to 10 years after a release was abated (ITRC 2018). Evidence that the LNAPL body at DU01 is stable includes:

- The source of LNAPL was removed 25 years ago in 1993;
- A total of 2,500 cubic yards of soil was removed from the source area during the 1993 tank removal;
- The LIF borings indicate there is a large vertical smear zone indicative of smearing and residualization of the LNAPL due to water table fluctuations; and
- The NYSDEC oversaw the over-excavation of the USTs and closed the original Spill Case, based on the results of the 1994 Site Assessment Report and observations during the excavation suggesting limited mobile LNAPL in the vicinity of the source.

Recoverability and Transmissivity of LNAPL

The recoverability of LNAPL is influenced by many factors, including LNAPL saturation, soil permeability, and physical properties of the LNAPL. LNAPL transmissivity represents the volumetric rate of LNAPL flow through a unit width of porous media per unit time, under a unit hydraulic gradient. A direct mathematical relationship exists between LNAPL transmissivity and the rate of LNAPL flow into a well; therefore, LNAPL transmissivity is an ideal parameter for assessing LNAPL recoverability. LNAPL transmissivity calculations inherently account for the combined effects of aquifer matrix permeability, LNAPL physical properties, and the relative proportion of pore space occupied by LNAPL within a specified vertical interval of aquifer material (i.e., LNAPL saturation). LNAPL recovery using hydraulic methods results in a negligible change in site conditions when the LNAPL transmissivity is less than 0.1 to 0.8 square foot per day (ft^2/day) (ITRC 2018). Therefore:

- **Recoverable LNAPL** can be defined as mobile LNAPL with transmissivity greater than the ITRC criterion.

LNAPL transmissivity is increasingly being applied as a quantitative indicator of LNAPL recoverability that can be used to focus and optimize LNAPL recovery efforts and, in the absence of risk-based LNAPL concerns, can be used to establish realistic LNAPL recovery end-points (ITRC 2018). LNAPL recovery using hydraulic methods (e.g., dual-phase extraction, skimmer pumping, vacuum truck operations) is typically not effective for areas where LNAPL transmissivity is less than 0.1 to 0.8 square feet per day (ft^2/day) (ITRC 2018).

The assessment of LNAPL recoverability at DU01 included evaluation of LNAPL transmissivity from bail-down tests. LNAPL bail-down tests were conducted at permanent monitoring well CH-MW017 and temporary piezometer PZ-3 to estimate the LNAPL transmissivity and recoverability; these locations were identified as the two locations with measureable LNAPL. Refer to the Phase II Investigation Field Report (**Appendix F**) for details on the bail-down test methodology and raw data.

Bail-down Test Data Analysis

LNAPL bail-down test data were analyzed using the American Petroleum Institute (API) LNAPL Transmissivity Workbook (API Workbook; API 2012). The following two methods were applied within the API workbook to analyze the LNAPL bail-down test data under unconfined conditions:

- B&R: Bouwer and Rice (1976)/Bouwer (1989)
- C&J: Cooper and Jacob (1946)/Jacob and Lohman (1952)

Each of these solutions involves different assumptions regarding the response of fluid levels within the well to the removal of LNAPL. Where possible, bail-down test data were evaluated using each of the solutions, and the LNAPL transmissivity is reported as the average of the results from each method.

Bail-down Test Results

The LNAPL transmissivity derived for each well using the API LNAPL Transmissivity Workbook (API 2012) for LNAPL bail-down tests completed at CH-MW017 and PZ-3 in December 2016 were 0.05 and 0.03 foot^2/day, respectively. LNAPL bail-down test results are summarized in **Table 4-1,** and graphical output from the API Workbook for each test is included in **Appendix J2**.

Prior to the bail-down test at CH-MW017, the initial thickness of LNAPL (three days after installation) was 1.98 ft. After 2 hours, the LNAPL had recovered to 1.57 ft; and after 4 days, the LNAPL had recovered to 2.81 ft at a similar potentiometric surface elevation. The additional recovery above the initial fluid levels indicates the LNAPL was not in equilibrium at the start of the test; therefore, the final measured fluid levels were used in the API workbook to estimate LNAPL transmissivity.

Prior to the bail-down test at PZ-3 (six months after installation), the initial thickness of LNAPL was 8.81 ft. Some groundwater was removed while evacuating LNAPL from the piezometer to initiate the bail-down test. Removing groundwater does not invalidate the test; however, it resulted in a complicated response. The fluid levels in the well were drawn down 5 ft below the initial LNAPL-water interface, and it took 48 hours for the fluid levels to return to the initial potentiometric surface, which is indicative of low soil permeability. Further, LNAPL did not re-enter the borehole for 70 minutes. Between 70 and 110 minutes, LNAPL thickness increased to 0.33 ft, and subsequently decreased to 0.18 ft as the groundwater continued to enter the well casing. After 48 hours, the potentiometric surface in the well had risen to pre-test conditions and the measured LNAPL was still 0.18 ft. After 96 hours of recovery measurements, the in-well LNAPL thickness remained at 0.18 ft. Refer to the Phase II Investigation Field Report (**Appendix F**) for the data from the bail-down tests.

The bail-down test at PZ-3 indicates the initial thickness was not representative of the extent of mobile LNAPL in the formation. The measured LNAPL thickness was stable over the final 48 hours of the test; therefore, it was assumed those conditions were representative of equilibrium conditions. The LNAPL transmissivity was estimated using the API LNAPL Transmissivity Workbook and assumptions that biased the results high, including analyzing the initial drainage into the well (likely filter pack drainage) and applying a drawdown adjustment (**Appendix J2**).

LNAPL is not effectively recovered through hydraulic methods when the LNAPL transmissivity is less than 0.1 to 0.8 ft^2/day (ITRC 2018). The estimated LNAPL transmissivity at CH-MW017 (0.05 ft^2/day) and PZ-3 (0.01 to 0.03 ft^2/day) is below the ITRC guidelines for effective recoverability. LNAPL bail-down tests indicate LNAPL is not practicably recoverable.

Natural Source Zone Depletion of LNAPL

Additionally, natural processes, as described in the ITRC technical guidance document *LNAPL Site Management: LNAPL Conceptual Site Model Evolution, Decision Process, and Remedial Technologies* (ITRC 2018), are likely depleting the LNAPL in the subsurface. NSZD is the combination of natural processes that decrease the mass of LNAPL in the subsurface over time. The mechanisms responsible for LNAPL depletion include volatilization, dissolution, and biodegradation. The significance of these mechanisms is related to the LNAPL properties (e.g., the volatility and solubility of LNAPL chemicals) and the site setting. The site setting considerations are related to the movement of soil gas and groundwater within the source zone, geochemistry, and microbial ecology.

Biodegradation of LNAPL constituents can occur through a number of microbially-facilitated reactions, depending on the availability of terminal electron acceptors (TEAs) such as oxygen, nitrate, manganese and iron oxides, and sulfate. Within LNAPL source zones, where hydrocarbon concentrations and electron acceptor demand are high, the above TEAs are depleted and methanogenesis often becomes the dominant degradation pathway. Methanogenesis proceeds in a LNAPL plume in the absence of external TEAs by utilizing byproducts of LNAPL fermentation, which does not require TEAs. During each of these biodegradation reactions, essentially all of the carbon present in hydrocarbon NAPLs is converted to carbon dioxide and methane. Due to low solubility, groundwater quickly becomes supersaturated with methane, which can then volatilize into the vadose zone and migrate upward.

In the vadose zone, LNAPL constituents may volatilize and redistribute into soil gas along with methane and carbon dioxide generated through biodegradation. As these gases migrate upward through the soil column through diffusive or advective transport processes and come into contact with higher concentrations of atmospheric oxygen, methane and volatilized LNAPL constituents are aerobically degraded (Sihota et al. 2011; McCoy et al. 2014). Typical rates measured at petroleum hydrocarbon sites range from hundreds to thousands of gallons per acre per year (Garg et al. 2017).

As discussed above, the lab reported that the LNAPL sample submitted for fingerprint analysis showed differences in relative peak intensities and ratios that indicated the product is weathered. Changes in the peak intensities and ratio, which represent changes in LNAPL composition, is indicative of natural processes depleting the LNAPL source.

Soil

Based on the Phase I and Phase II field investigations and the PSE, the Phase III field investigation included the collection of additional subsurface soil samples to assess potential site impacts. A total of 16 subsurface soil samples from DU01 were collected for metals, SVOC, and VOC analysis. In addition, 32 unbiased surface soil samples from the Phase II field investigation were used to assess potential site impacts. Nearly all metals were detected in surface and subsurface soil at DU01 in most of the sample locations, with the exception of antimony, mercury, and silver, which were detected in less than half of the surface and subsurface samples.

A total of 18 individual PAHs and eight non-PAH SVOCs were detected in surface soil, and a total of 18 individual PAHs and four non-PAH SVOCs were detected in subsurface soil. PAHs were detected in nearly all of the surface and subsurface soil samples. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in surface and subsurface soil. Eight VOCs were detected in surface soil, with a low frequency of detection. Only two VOC compounds (2-butanone and acetone) were detected in more than a quarter of the samples. A total of 17 VOCs were detected in subsurface soil, also with a low frequency of detection. Only one VOC compound (acetone) was detected in more than a quarter of the samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, barium, cobalt, lead, manganese, nickel, thallium, zinc, acetone, and several SVOCs in surface soil and aluminum, arsenic, hexavalent chromium, cobalt, thallium, vanadium, and several PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that cobalt, manganese, nickel, and zinc in surface soil and aluminum, hexavalent chromium, cobalt, thallium, and vanadium in subsurface soil are consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none of these chemicals were retained as COCs.

Surface Water and Sediment

A nearby stream is located to the downgradient from DU01. As part of the Phase III field investigation, a Y-shaped stream segment was established as SEA06 to assess potential impacts to surface water and sediment from DU01 (upgradient from SEA06), DU02 (adjacent to and east of SEA06), and DU03 (includes the western branch of SEA06). A total of 14 surface water and 15 sediment samples (locations CH-SWSD111 through CH-SWSD125) were collected from SEA06 for analysis of SVOCs and metals.

Section 4.2.6 provides a summary of COPC selection and potential impacts within SEA06, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in sediment. Total chromium and zinc were identified as COPCs in surface water. However, the results of the

HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks; thus, no COCs were retained in SEA06 surface water.

Groundwater

Groundwater at DU01 was sampled in nine monitoring wells (CH-MW016, CH-MW018, CH-MW019, CH-MW020, CH-MW021, CH-MW022, CH-MW023, CH-MW024, and CH-MW025). Seven monitoring wells (CH-MW016 though CH-MW022) were located within the immediate vicinity of DU01, and three additional wells (CH-MW023 through CH-MW025) were located further downgradient from DU01 to assess potential impacts from the former AST35 and FPH AOCs, as well as DU01. Two rounds of samples were collected from monitoring wells CH-MW016 through CH-MW021 (December 2016 and June 2017), and one round of samples was collected from monitoring wells CH-MW022 through CH-MW025 (June 2017). LNAPL was present in monitoring well CH-MW017 during both sampling events; therefore, a groundwater sample was not collected from this location during either sampling event.

Groundwater at DU01 was analyzed for VOCs, SVOCs, and metals as part of the sitewide groundwater monitoring well network. Although the sitewide network was evaluated for only SVOCs and metals, VOC analysis was added for wells in the vicinity of DU01 due to the presence of LNAPL. A total of 23 metals were detected in total groundwater and 21 metals were detected in the dissolved groundwater fraction. Nearly all metals were detected in groundwater at DU01 in most of the samples, with the exception of antimony, beryllium, cadmium, hexavalent chromium, mercury, selenium, silver, and thallium, which were detected in less than half of the samples.

A total of 10 individual PAHs and seven additional SVOCs were detected in total groundwater from DU01, with a low frequency of detection (only 1-methylnaphthalene and acenaphthene were detected in half or more of the samples). Nine individual PAHs and five additional SVOCs were detected in the dissolved groundwater fraction, with a low frequency of detection (only naphthalene was detected in more than half of the samples). The maximum detection of each compound typically occurred at monitoring well CH-MW016, which is located near the downgradient edge of the LNAPL plume (**Figure 4-1d**).

A total of 23 VOCs were detected in total groundwater, with a low frequency of detection (each compound was only detected in less than 30% of the samples). Similar to the SVOC detections, the maximum detection of each VOC typically occurred at monitoring well CH-MW016, with the exception of 2-butanone and acetone, which had maximum detections at CH-MW019 that occurred during the Phase II field event. VOCs were only detected in monitoring wells CH-MW016, CH-MW019, and CH-MW021 during the Phase II field event. VOCs were only detected in monitoring wells CH-MW016 and CH-MW024 during the Phase III event. All other wells at DU01 had no VOCs detected. **Appendix B2** includes tables of all analytical results.

As presented in Section 6.0, the following compounds were retained as COPCs in total groundwater for the direct contact/incidental ingestion construction worker pathway, based on the background evaluation and initial HHRA risk screening process: aluminum, arsenic, beryllium, total chromium, hexavalent chromium, iron, manganese, vanadium, 1-methylnaphthalene, 2-methylnaphthalene, naphthalene, 1,1'biphenyl, dibenzofuran, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-butanone, acetone, benzene, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, m,p-xylene, n-propylbenzene, trichloroethene, and xylenes. The following compounds were retained as COPCs in total groundwater for the vapor intrusion pathway: 1,1'-biphenyl, naphthalene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, ethylbenzene, and trichloroethene.

The total groundwater results were used for evaluating the construction worker scenario because direct contact with shallow groundwater seeping into a trench is unlikely to be treated or filtered. A quantitative geochemical evaluation was not conducted for metal COPCs in groundwater due to the variability of geochemical conditions in groundwater and the influence of particulates, which could lead to erroneous conclusions if datasets with variable conditions were combined. Therefore, all of the total groundwater COPCs were retained to assess risk for the construction worker trench scenario in the HHRA.

The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none of these chemicals were identified as COCs. Additional details of the HHRA are discussed in Section 6.0.

Nature and Extent Summary and Potential Risks

In summary, the extent of investigation at DU01 is sufficient to complete the RI phase of the CERCLA process. The presence of LNAPL requires further consideration based on the characteristics described herein, and whether a follow-up response action should be considered. As presented in Section 6.0, none of the COPCs in soil, groundwater, surface water, or sediment were identified as COCs after the completion of the HHRA and ERA.

The LNAPL at DU01 has been relatively well-delineated and evaluated based on several analytical techniques presented in this report including LIF investigations, soil borings, observed in-well LNAPL accumulations, and bail-down testing. Although some mobile LNAPL is present at the site, the LNAPL appears to be stable, the mobile fraction of LNAPL does not appear to be recoverable, and NSZD processes appear to be actively depleting the LNAPL source. The following bullets summarize the LNAPL characteristics at DU01:

- Laboratory analysis indicated that the LNAPL was most similar to the laboratory's Diesel/#2 Fuel Oil reference chromatogram, consistent with the suspected source.
- The source of LNAPL was removed 25 years ago in 1993.
- The LIF borings indicate there is a large vertical smear zone indicative of smearing and residualization of the LNAPL due to water table fluctuations, as shown on the DU01 CSM (**Figure 4-1g**).
- LNAPL transmissivity estimated from bail-down tests, completed at both wells with measureable LNAPL, are consistent with the overall findings that the LNAPL is stable and not recoverable. LNAPL transmissivity values are below the ITRC criterion range of 0.1 to 0.8 foot^2/day for transmissivity, indicating limited recovery potential via hydraulic methods.
- The weathered LNAPL sample suggests that NSZD processes are active at the site and are actively depleting the LNAPL source.
- The HHRA risk results for non-residential receptors from exposure to petroleum-related COPCs at DU01 were below the USEPA target risk thresholds.

Further assessment and/or response action related to the LNAPL is subject to USACE program review. However, the LNAPL stability, lack of recoverability, and evidence of active depletion should be considered in evaluating whether a response action is warranted.

4.1.2 DU02: H-2 Drum Area

4.1.2.1 Overview and Historical CSM

DU02 is a 0.5-acre DU established to assess potential impacts from an existing 55-gallon metal drum (AOC H-2). The DU encompasses an existing empty drum along the fence in the eastern portion of the DU; the former drum contents are unknown. This DU is intended to assess potential impacts and exposures west of the fence in the direction of overland surface water flow and groundwater flow. An adjacent DU (DU01) was established to assess the area east of the fence, which is primarily focused on historical petroleum impacts (Section 4.1.1). The location of this DU within Camp Hero is illustrated on **Figure 2-4** and site-specific detail on **Figure 4-2a**. VOCs, SVOCs, PCBs, and metals were assessed in surface and shallow subsurface soil during the Phase I RI field investigation; however, only metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, unbiased surface soil sampling was completed for metals during the Phase III RI field investigation.

The Phase III dataset obtained for DU02 includes surface soil, as well as nearby surface water and sediment. Although no streams directly transect this DU, surface water and sediment samples were collected from a nearby stream (represented by locations within SEA06). Those samples were collected to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of this area, specifically from CH-MW018 and CH-MW019, was assessed as part of the sitewide network of groundwater monitoring wells. These nearby locations are used for presenting nearby geology and hydrogeology characteristics in the near vicinity of DU02, but are not associated with DU02 from a nature and extent of contamination perspective.

4.1.2.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU02.

Description and Current Use

DU02 is located immediately west of DU01, in the southwestern portion of Camp Hero. The topography of DU02 is sloped from east to west from the hill at DU01. Moving west across DU02, the topography quickly flattens and slopes into the non-revetted stream channel (SEA06) to the northwest of DU02. Land cover is predominantly a forested wetland; however, shrubs and bushes have greater density as the topography becomes less severe and flattens in the central and western portions of DU02. Wetland conditions were observed within the entire DU, consistent with the NYSDEC state mapped wetland boundary (Class 2). Currently, DU02 is undeveloped with limited access. No plans for development or future use are proposed.

Geology

The geology of DU02 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-9** depicts the geologic cross section of DU01 and DU02). No subsurface soil sampling or monitoring well installation was warranted during the Phase III RI field investigation at DU02 based on the CSM. However, two wells (CH-MW018 and CH-MW019) were installed upgradient of DU02 to characterize groundwater flow and potential impacts migrating from DU01. The soil logged from these two monitoring wells was consistent with other monitoring wells installed in the near vicinity. Soil generally consisted of a silty sand matrix with interspersed thin lenses of silt and clay. At depth, the percentage of silt and clay increased. Moisture content of the soil in the recovered cuttings was wet at approximately 5 to 10 ft bgs.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 26 and 28 June 2017. Groundwater elevations range from 55.02 ft amsl at CH-MW018 to 74.37 ft amsl at CH-MW019. Groundwater contours are shown on **Figure 3-3**. Groundwater flows east to west towards the wetland at DU02 and SEA06. At the time of surface soil sampling, no surface water flow was observed within DU02; however, water was observed in select surface soil locations at a depth of 1 foot bgs. No water quality or MNA data were collected within DU02 because groundwater specifically within DU02 did not warrant assessment based on the CSM.

Habitat and Ecological Setting

DU02 encompasses a 0.5-acre parcel, which includes wooded wetlands and dense vegetation. Vegetation in the eastern portion of the DU is characterized as mesic open thicket with shrubby thicket. Wet woods are located in the western portion of the DU, with common reed (*P. australis* ssp.) dominating wetlands to the north. Other dominant species include red maple (*Acer rubrum*), Japanese honeysuckle (*L. japonica*), Morrow's honeysuckle (*L. morrowii*), wineberry (*Rubus phoenicolasius*), grape (*Vitis* spp.), common flat-top goldenrod (*E. graminifolia*), and horse nettle (*Solanum carolinense*).

Wetland conditions were observed across the entire DU during the Phase III field effort, consistent with the NYSDEC state mapped wetland boundary (Class 2), with additional palustrine forested wetlands located downgradient to the southwest. Drainage within DU02 is generally to the west into woods and towards the non-revetted stream channel represented by SEA06.

4.1.2.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from an existing drum (AOC H-2). The sampling design consisted of biased sampling in the immediate vicinity of the drum to target potential source areas. Parameter groups included VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil and shallow subsurface soil samples. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. No potential impacts were identified in subsurface soil. The full analytical results are provided in **Appendix B2**, and the sampling locations associated with the Phase I RI field investigation are provided in **Appendix E**.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU02 for metals in surface soil. The Phase III program also included the collection of nearby groundwater, surface water, and sediment samples to assess potential impacts associated with DU02. **Exhibit 4-2** provides the progression of the field sampling implemented at DU02. The full analytical results are provided in **Appendix B2**, and the sampling locations associated with the Phase III field investigation at DU02 are illustrated on **Figure 4-2a**.

Exhibit 4-2. DU02 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4]	--	--	**SEA06** *Quantity:* 14 Total, 5 Dissolved *Analyses:* SVOCs[5], metals[4], hardness	**SEA06** *Quantity:* 15 *Analyses:* SVOCs[5], TOC, metals[4]

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Potential impacts from metals in surface soil were identified at DU02 based on the Phase I field investigation and the PSE. No potential impacts were identified from other parameters in surface soil, and no potential impacts were identified from any parameters in subsurface soil. Based on these results, the Phase III field investigation included the collection of 16 surface soil samples for evaluation of metals.

All metals were detected in surface soil at DU02 during the Phase III field investigation in most of the sample locations, with the exception of infrequent detections of antimony and silver. Tables of all analytical results are provided in **Appendix B2**.

As presented in Section 6.0, arsenic, barium, cadmium, total chromium, hexavalent chromium, cobalt, lead, mercury, nickel, thallium, vanadium, and zinc were retained as COPCs in surface soil based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that arsenic, barium, total chromium, hexavalent chromium, cobalt, nickel, thallium, vanadium, and zinc were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

A nearby stream is located to the west of DU02. As part of the Phase III field investigation, a Y-shaped stream segment was established as SEA06 to assess potential impacts to surface water and sediment from DU01 (upgradient from SEA06), DU02 (adjacent to and east of SEA06), and DU03 (includes the western branch of SEA06). A total of 14 surface water and 15 sediment samples (locations CH-SWSD111 through CH-SWSD125) were collected from SEA06 for analysis of SVOCs and metals.

Section 4.2.6 provides a summary of COPC selection and potential impacts within SEA06, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in sediment. Total chromium and zinc were identified as COPCs in surface water; however, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks, and thus, no COCs were retained in SEA06 surface water.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU02. Section 4.3 provides a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU02 is sufficient to complete the RI phase of the CERCLA process. The analytical results and associated COPCs at DU02 are consistent with the CSM for a former drum remnant on the ground surface. COPCs retained for surface soil (cadmium, lead, and mercury) and surface water (total chromium and zinc) were evaluated for associated risks in the HHRA and/or the ERA. No COPCs were identified in sediment.

As presented in Section 6.0, the results of the HHRA and ERA concluded that none of the COPCs retained for evaluation at DU02 or in the downgradient SEA06 posed unacceptable risks in the context of the CERCLA risk assessment guidance. No COCs are retained and no further assessment or response action is warranted for DU02.

4.1.3 DU03: H-1 Drum Area

4.1.3.1 Overview and Historical CSM

DU03 is a 0.5-acre DU established to assess potential impacts from an existing 55-gallon metal drum located (AOC H-1) in the wooded wetlands south of Battery 112. Potential environmental impacts were identified based on the presence of the empty drum; however, the former drum contents are unknown. The existing drum remnant located at the center of the DU. The location of this DU within Camp Hero is illustrated on **Figure 2-4**, and site-specific detail on **Figure 4-3a**.

VOCs, SVOCs, PCBs, and metals were assessed in surface and shallow subsurface soil in this area during the Phase I RI field investigation. Based on the PSE, metals in surface soil and SVOCs in surface and subsurface soil exceeded preliminary risk screening criteria and BTVs (**Appendix G**). Therefore, DU03 was designed to complete unbiased sampling for metals in surface soil and SVOCs in surface and subsurface soil during the Phase III RI field investigation. Wetland conditions were observed (not state-mapped) throughout the majority of the DU during the Phase III event. Wetland avoidance and minimization BMPs included the collection of all soil samples using a hand auger instead of a direct push drill rig, consistent with the protocols established in the SAP (AECOM-Tidewater JV 2017). Therefore, all subsurface soil samples were collected from 1 to 2 ft bgs.

The Phase III dataset obtained for DU03 includes surface and subsurface soil, as well as surface water and sediment. Two streams (represented by SEA06) directly transect DU03 and converge in the southern portion of the DU. Surface water and sediment samples were collected from both channels to evaluate impacts from DU03 and to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of DU03 did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.3.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU03.

Description and Current Use

DU03 is located in the southwestern portion of Camp Hero, south of Battery 112 (an existing underground bunker). The topography of DU03 is situated on a slope from the northern portion at Battery 112 to the southern portion of the DU. Two streams converge in the southern portion of the DU, one from the northwest and one from the east (both of which comprise SEA06), creating a topographic low in the southern half of DU03. Land cover is predominantly wooded wetlands, encompassing an estimated 90% of the DU. The wetlands are thinly forested, and a higher density of low-growing bushes is on the western side of the DU. The area is bounded to the southeast by a palustrine forested wetland. The Paumanok Path/Point Woods Trail passes to the east and south of DU03, providing access to Battery 112 and scenic overlooks along the southern bluffs.

Access to the site is limited based on the wetland conditions. No plans for development or future use are proposed, other than the continued use of the Paumanok Path hiking trail to the east and south of DU03.

Geology

The geology of DU03 is generally consistent with the sitewide geology characterized in Section 3.2. No deep subsurface soil borings or monitoring wells were advanced within DU03. Surface and shallow subsurface soil samples (1 to 2 ft bgs) were collected via hand auger. Surface and shallow subsurface soil generally consisted of a silty sand matrix with interspersed thin lenses of silt and clay. Additionally, the surface soil contained a high percentage of organic material (roots and decayed vegetation). Moisture content varied greatly across DU03. The upland portion of DU03 (northern end) remained dry; however, surface soils within the southern portion were considered wet to saturated.

Hydrogeology and Groundwater Conditions

No groundwater monitoring wells were installed within or near DU03; however, localized groundwater contours were approximated and are shown on **Figure 3-3**. Groundwater flow direction is south following the general topographic features and flow direction of SEA06.

Habitat and Ecological Setting

DU03 encompasses a 0.5-acre parcel with dense vegetation and two non-revetted stream channels (represented by SEA06) flowing across the DU. Wetland conditions were observed across approximately 90% of the DU during the Phase III field effort. The northern corner of the DU is at a slightly higher elevation than the rest of the DU with dryer conditions and no wetlands. Drainage across the DU is to the southeast towards palustrine forested wetlands located downgradient of the DU.

Mesic-moist semi-open woods and thickets are dominated by red maple (*A. rubrum*), privet (*Ligustrum* spp.), American holly (*Ilex opaca*), mountain laurel (*Kalmia latifolia*), highbush blueberry (*V. corymbosum*), alder (*Alnus* spp.), common reed (*Phragmites australis* ssp.), and cinnamon fern (*Osmunda cinnamomea*). Some London plane (*Platanus x hispanica*) trees were also present and may represent historical ornamental plantings. Southern arrowwood (*V. dentatum var. venosum*; a state threatened species) was observed within the DU boundary.

4.1.3.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a former drum location (AOC H-1). The sampling design consisted of biased sampling in the immediate vicinity of the drum to target the potential source area. Samples were collected for analysis of VOCs, SVOCs, PCBs, and metals (except mercury) in surface and shallow subsurface soil. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil and SVOCs in surface and subsurface soil. Because VOCs and PCBs did not exceed the preliminary risk screening criteria or BTVs, no further sampling those parameters was performed.

The full analytical results are provided in **Appendix B2**, and the sampling locations associated with the Phase I RI field investigation are provided in **Appendix E**.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU03 for metals in surface soil and SVOCs in surface and subsurface soil. As described above, wetland conditions were observed (not state-mapped) throughout the majority of the DU, and therefore all subsurface soil samples were collected from 1 to 2 ft bgs. The Phase III program also included the collection of surface water and sediment samples to assess potential impacts associated with DU03. **Exhibit 4-3** provides the progression of the field sampling implemented at DU03. Refer to **Appendix B2** for the full analytical results and **Figure 4-3a** for the sampling locations associated with the Phase III field investigation at DU03.

Exhibit 4-3. DU03 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	--	**SEA06** *Quantity:* 14 Total, 5 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA06** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples from DU03 were collected for metals and SVOC analysis, and 16 subsurface soil samples were collected for SVOC analysis. All metals were detected in surface soil at DU03 during the Phase III field investigation in most of the sample locations, with the exception of antimony and silver, which were each only detected once. PAHs were detected in nearly all of the surface and subsurface soil samples. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in either surface or subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, mercury and benzoic acid in surface soil and Total PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation did not eliminate mercury as a COPC (**Appendix L2**). The results of the HHRA and ERA concluded that none of the COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

A stream is located within wetlands in the center of DU03 and flows southeast to join a stream channel flowing in from the vicinity of DU02. The combined stream channel then flows to the south. As part of the Phase III field investigation, a Y-shaped stream segment was established as SEA06 to assess potential impacts to surface water and sediment from DU01 (upgradient from SEA06), DU02 (adjacent to and east of SEA06), and DU03 (includes the western branch of SEA06). All portions of SEA06 are non-revetted. A total of 14 surface water and 15 sediment samples (locations CH-SWSD111 through CH-SWSD125) were collected from SEA06 for analysis of SVOCs and metals.

Section 4.2.6 provides a summary of COPC selection and potential impacts within SEA06, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in sediment. Total chromium and zinc were identified as COPCs in surface water. However, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks; thus, no COCs were retained in SEA06 surface water.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU03. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU03 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and SVOCs in surface soil and SVOCs in subsurface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, benzoic acid and mercury were retained as surface soil COPCs, and PAHs were retained as COPCs in subsurface soil. However, these COPCs did not pose potentially unacceptable risks and no COCs are retained for DU03 soil.

In the downgradient SEA06, no COPCs were retained in sediment and none of the COPCs retained in surface water posed unacceptable risks to humans or ecological receptors. No COCs are retained for DU03 and no further assessment or response action is warranted for DU03.

4.1.4 DU04: H-18 Former Drum Location

4.1.4.1 Overview and Historical CSM

DU04 is a 0.5-acre DU established to assess potential impacts from a former 55-gallon drum (AOC H-18) in the operational and recreational area along a gravel access road north of Battery 112. Potential environmental impacts were identified based on the former presence of the drum; however, the former drum contents are unknown. A drum was not identified at this location during field operations; however, potential drum remnants were located via magnetometer during the Phase I field investigation. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-4a** for site-specific detail.

VOCs, SVOCs, PCBs, and metals were assessed in surface and shallow subsurface soil during the Phase I RI field investigation; however, only metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, unbiased surface soil sampling was completed for metals during the Phase III RI field investigation.

The dataset obtained for DU04 includes surface soil. No stream features were located in the vicinity of this DU, and groundwater did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.4.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU04.

Description and Current Use

DU04 is located north of Battery 112 in the southwestern portion of Camp Hero. The topography of DU04 is generally flat, but bordered by steep terrain to the northeast and west. Land cover across DU04 is thinly forested. The Battery 112 trail runs along the western side of the DU. Two gravel access roads connect within the DU, which lead around Battery 112 to the south and to Camp Hero Road to the north. No NYSDEC-mapped wetlands are in this area, and no wetlands were observed during the Phase III field investigation.

DU04 is accessible along the road and paths; visitors often walk through the area to view Battery 112. NYSOPRPH proposed plans for development include a possible future camping area west of DU04.

Geology

The geology of DU04 is generally consistent with the sitewide geology characterized in Section 3.2. No subsurface soil sampling or monitoring well installation was conducted within DU04. Surface soil generally consisted of a silty sand matrix with interspersed thin lenses of silt and clay. Moisture content was dry to moist.

Hydrogeology and Groundwater Conditions

No groundwater monitoring wells were installed within or adjacent to DU04; however, localized groundwater contours were approximated based on other groundwater elevation data and topographic characteristics, as shown on **Figure 3-3**. The local groundwater flow direction is northwest across the DU; however, the broader groundwater flow in the vicinity of the DU exhibits a gentle radial pattern that flows outwardly, away from Battery 112.

Habitat and Ecological Setting

DU04 encompasses a thinly wooded 0.5-acre parcel containing mixed hardwood forest dominated by oak (*Quercus* spp.), Norway maple (*Acer platanoides*), and American basswood (*Tilia americana*). Few shrubs are present, and garlic mustard (*Alliaria petiolate*) dominates the herbaceous layer. Portions of the DU are covered by a gravel access road associated with the existing structures and the Battery 112 trail. These areas are unlikely to provide habitat for wildlife. No wetland conditions were observed within the DU. Overland flow from the DU drains towards palustrine forested wetlands located downgradient to the west-northwest.

4.1.4.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a former drum location (AOC H-18). The sampling design consisted of biased sampling in the immediate vicinity of where the former drum was purportedly located to target potential source areas. Samples were collected for analysis of VOCs, SVOCs, PCBs, and metals (except mercury) in surface and shallow subsurface soil. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. Because VOCs, SVOCs, and PCBs in surface soil did not exceed the preliminary risk screening criteria or BTVs, no further sampling of those parameters was performed. No potential impacts were identified in subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

Based on the Phase I results and the PSE, the Phase III RI field investigation was designed to establish an unbiased sampling grid for metals in surface soil. **Exhibit 4-4** provides the progression of the field sampling implemented at DU04. Refer to **Appendix B2** for the full analytical results and **Figure 4-12a** for the sampling locations associated with the Phase III field investigation at DU04.

Exhibit 4-4. DU04 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4]	--	--	--	--

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface soil samples to assess potential site impacts. No further assessment was required for subsurface soil or other site media. A total of 16 surface soil samples from DU04 were collected for metals analysis. The majority of metals were detected in most of the surface soil samples collected. Antimony, cadmium, and mercury were detected in less than half of the samples analyzed, and silver was not detected in any of the samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, none of the metals were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process.

Surface Water and Sediment

No SEAs are in the vicinity of DU04.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU04. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU04 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, none of the metals were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. Accordingly, per the CERCLA process, no further assessment or response action is warranted for DU04.

4.1.5 DU05: WDS Cesspool Area

4.1.5.1 Overview and Historical CSM

DU05 is a 0.5-acre DU established to assess potential impacts from former cesspools associated with the abandoned sitewide WDS. The abandoned sitewide WDS was identified during the 2016 historical records search from archive drawings, which indicated that septic fields and cesspools were also used at Camp Hero prior to the construction of the sitewide WDS. The DU05 boundary encompasses the three former cesspools and the area to the east, in the direction of overland surface water flow and groundwater flow. It is bounded by Camp Hero Road to the west. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-5a** for site-specific detail.

Potential impacts were identified because hazardous waste discharges related to the cesspools within the WDS were suspected. VOCs, SVOCs, PCBs, and metals were assessed in subsurface soil during the Phase I RI field investigation (as part of the WDS AOC with borings WDS-SB25 to WDS-SB27); however, only metals in subsurface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). The presence of metals in subsurface soil in excess of screening criteria and BTVs could be an indication that metals in surface soil posed potential environmental impacts and were not captured in the Phase I sampling effort. Therefore, unbiased surface and subsurface soil sampling was completed for metals during the Phase III RI field investigation.

The majority of DU05 contains portions of steep terrain; sample locations were offset to areas accessible to the drill rig. Additionally, wetland conditions were observed (not state-mapped) in the eastern portion of the DU. Wetland avoidance and minimization BMPs included the collection of surface and subsurface soil samples within wetland boundaries using a hand auger instead of a direct push drill rig, consistent with the protocols established in the SAP (AECOM-Tidewater JV 2017). As a result, 4 subsurface soil samples located in wetland areas (DU05-S003, DU05-S007, DU05-S011, and DU05-S015) were collected from 1 to 2 ft bgs via hand auger and 11 subsurface soil samples in non-wetland areas were collected from 1 to 10 ft bgs via direct push. One subsurface soil sample (DU05-S009) was collected from 1 to 5 ft bgs via direct push because the drill rig encountered a void space from 5 to 10 ft bgs.

The Phase III dataset obtained for DU05 includes surface and subsurface soil, as well as surface water and sediment. Surface water and sediment samples were collected from a stream channel in the eastern portion of the DU (represented by SEA05) to assess impacts from DU05, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of this area did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.5.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU05.

Description and Current Use

DU05 is located in the western portion of Camp Hero along Camp Hero Road. The topography of DU05 is terraced, generally sloping from west to east, towards the stream channel represented by SEA05. Land cover is mixed hardwood forest in the western half of the DU, while wetlands associated with the stream channel cover approximately 40% of the DU in the eastern portion. Currently, DU05 is undeveloped with limited access, based on the upper forested steep terrain and lower downgradient wetlands. No plans for development or future use of DU05 are proposed; however, nearby DU06 is currently used by the NYSOPRHP as a picnic and camping area.

Geology

The geology of DU05 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-11** depicts the geologic cross section of DU05 and DU06). No monitoring well installation was conducted within or near DU05; however, subsurface soil borings were advanced across DU05. Subsurface soil generally consisted of a silty sand layer in the top 1 ft bgs followed by a moderately dense, poorly sorted sand/silty sand unit to 7 to 8 ft bgs. Underlying the sand was a layer of a high percentage of silt and clay to 10 ft bgs. Moisture content was dry to moist.

Hydrogeology and Groundwater Conditions

No groundwater monitoring wells were installed within or near DU05; however, localized groundwater contours were approximated and are shown on **Figure 3-3**. Groundwater flow direction is northeast towards SEA05 following the general topographic features of the slopes.

Habitat and Ecological Setting

DU05 encompasses a densely wooded 0.5-acre parcel with steep inclines. Wetland conditions cover approximately 40% of the DU and are present at the bottom of the incline in the eastern portion of the DU. A stream channel (represented by the southern branch of SEA05) begins in wetlands located just south of the DU and flows north through the wetlands in the DU. The majority of the stream channel is revetted; as such, it was classified as a revetted SEA during the risk assessments. The DU contains mixed hardwood forest with wet areas near the stream and wetlands and mesic areas on the upper banks.

The hardwood forest contains oak (*Quercus* spp.), birch (*Betula* spp.), red maple (*A. rubrum*), American basswood (*T. americana*), Norway maple (*Acer platanoides*), privet (*Ligustrum* spp.), witch hazel (*Hamamelis virginiana*), American holly (*Ilex opaca*), Japanese blackberry (*Berberis thunbergii*), Japanese honeysuckle (*Lonicera japonica*), common greenbrier (*Smilax rotundifolia*), oriental bittersweet (*Celastrus orbiculatus*), grape (*Vitis* spp.), skunk cabbage (*Symplocarpus foetidus*), and common flat-top goldenrod (*Euthamia graminifolia*). London plane (*P. x hispanica*) trees were also present along Camp Hero Road and may represent historical ornamental plantings. Southern arrowwood (*V. dentatum var. venosum*; a state threatened species) was observed within DU05 along Camp Hero Road.

4.1.5.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from cesspools associated with the abandoned sitewide WDS (including Phase I borings WDS-SB25 to WDS-SB27). The sampling design consisted of biased sampling to target the potential source area. Parameter groups consisted of VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in subsurface soil. Because VOCs, SVOCs, and PCBs did not exceed the preliminary risk screening criteria or BTVs, no further sampling of those parameters was performed. Based on the exceedances of metals in subsurface soil, surface soil also warranted further evaluation for metals. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU05 for metals in surface and subsurface soil. As described above, the depth of the subsurface soil samples varied due to steep terrain, wetland conditions, and a subsurface void space. The Phase III program also included the collection of nearby surface water and sediment samples to assess potential impacts associated with DU05. **Exhibit 4-5** provides the progression of the field sampling implemented at DU05. Refer to **Appendix B2** for the full analytical results and **Figure 4-5a** for the sampling locations associated with the Phase III field investigation at DU05.

Exhibit 4-5. DU05 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	--	*Quantity:* 3 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 3 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4]	*Quantity:* 16 *Analyses:* metals[4]	--	**SEA05** *Quantity:* 13 Total, 11 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA05** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface soil and subsurface soil samples to assess potential site impacts due to metals. No further assessment was required for organics. A total of 16 surface soil samples and 16 subsurface soil samples from DU05 were collected for metals analysis. The majority of metals were detected in most of the soil samples collected. Antimony and silver were detected in less than half of the surface soil samples, and cadmium, mercury, and silver were detected in less than half of the subsurface soil samples. Antimony was not detected in any of the subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, lead and mercury in surface soil and arsenic in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that arsenic was consistent with natural conditions; thus, it was eliminated as a COPC (**Appendix L2**). The geochemical evaluation did not eliminate lead or mercury as COPCs. The results of the HHRA and ERA concluded that none of the COPCs identified in surface soil posed potentially unacceptable risks, and thus, no COCs were identified for DU05 surface soil.

Surface Water and Sediment

As part of the Phase III field investigation, a stream channel passing through DU05 is included as part of SEA05, which was established to assess potential impacts to surface water and sediment from DU05 and DU06. As mentioned previously, the majority of the SEA05 is revetted; therefore, it was classified as a revetted SEA during the risk assessments. A total of 14 surface water and 15 sediment samples (locations CH-SWSD096 through CH-SWSD110) were collected from SEA05 for analysis of SVOCs and metals.

Section 4.2.5 provides a summary of COPC selection and potential impacts within SEA05, and **Appendix B2** provides tables of all analytical results. Individual PAHs and several PAH totals were identified as COPCs in surface water and selenium, bis(2-ethylhexyl)phthalate, and two individual PAHs (1-methylnaphthalene and 2-methylnaphthalene) were identified as COPCs in sediment. However, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks, and thus, no COCs were identified in SEA05 surface water or sediment.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU05. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU05 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface and subsurface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, none of the metals were identified as COCs after the completion of the HHRA and ERA. Accordingly, per the CERCLA process, no further assessment or response action is warranted for DU05.

4.1.6 DU06: Former Power Plant Area

4.1.6.1 Overview and Historical CSM

DU06 is a 0.5-acre DU established to assess potential impacts from the former Power Plant (AOC H-11), a former Sewage Ejector Station (AOC H-12), and a tile field associated with the abandoned sitewide WDS (including Phase I borings WDS-SB23 and WDS-SB24). Tile fields are subsurface wastewater disposal facilities used to remove chemicals and impurities from the liquid that emerges after anaerobic digestion in a septic tank. The tile fields typically consisted of an arrangement of trenches containing perforated vitrified clay pipe (with a salt glazing applied to both the interior and exterior surfaces of the pipe) and porous material (often gravel) covered by a layer of soil to prevent animals (and surface runoff) from reaching the wastewater distributed within those trenches. The DU boundary encompasses these three former operational areas and is bound by Daniel Road to the east. Residual coal fragments were observed throughout the southwestern portion of the DU along the ground surface and in shallow subsurface soil. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-6a** for site-specific detail.

During the Phase I RI field investigation, SVOCs (PAHs only), PCBs, and metals (except mercury) were assessed in surface and subsurface soil at the former Power Plant (AOC H-11); VOCs, SVOCs, PCBs, and metals (except mercury) were assessed in surface and subsurface soil at the former Sewage Ejector Station (AOC H-12); VOCs, SVOCs, PCBs, and metals (except mercury) were assessed in subsurface soil at the tile field (borings WDS-SB23 and WDS-SB24) as part of the abandoned sitewide WDS AOC. Based on the PSE, lead in surface soil, in addition to PAHs and metals in subsurface soil, exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Given that potential contamination at this DU would be expected to be from surface sources (rather than subsurface sources), the presence of PAHs in subsurface soil in excess of screening criteria and BTVs could be an indication that PAHs in surface soil posed potential environmental impacts and were not captured in the Phase I sampling effort. Therefore, unbiased surface and subsurface soil sampling was completed for metals and SVOCs during the Phase III RI field investigation.

The Phase III dataset obtained for DU06 includes surface and subsurface soil, as well as groundwater, surface water, and sediment. Surface water and sediment samples were collected from a stream channel that flows through the western portion of the DU (represented by SEA05) to assess impacts from DU06, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in this area, specifically from CH-MW041 and CH-MW042, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.6.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU06.

Description and Current Use

DU06 is located in the western portion of Camp Hero State Park along Daniel Road. The topography of DU06 is relatively flat, with a slight slope to the southwest towards a stream channel represented by SEA05.

The DU encompasses the footprints of the former Heating Plant and the southern portion of former Building 6 (Mess Hall). The DU also includes multiple features associated with the abandoned sitewide WDS, including the former Sewage Ejector Station, a septic line, a drain tile field, and sanitary sewer lines. A relatively small portion of the DU contains wetlands, observed along the southwestern edge of the DU during the Phase III field investigation. Residual coal fragments were observed on the ground surface in the southwestern portion of the DU, to the north of the wetlands.

Access to the site is virtually unlimited via Daniel Road, located immediately east of DU06. Land cover is an open, park-maintained lawn. The DU is currently used as a public recreational area with picnic tables and grills. The area is also used as a private camping area for events approved by the NYSOPRHP. The future use is intended to remain the same.

Geology

The geology of DU06 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-11** depicts the geologic cross section of DU05 and DU06). Two monitoring wells were installed (CH-MW041 and CH-MW042) and subsurface soil borings were advanced within the DU06 boundary. Subsurface soils generally consisted of a silty sand/sand matrix with interspersed thin lenses of silt and clay and trace amounts of gravel. The initial 10 ft of subsurface soil consisted of alternating layers of moderately dense silty sand units and loose sand deposits. Below 10 ft bgs, soil composition became more uniform with a higher percentage of fine sand, silt, and trace amounts of clay. Moisture content of the soil in the recovered cuttings was moist to wet in places. Although there was no clear presence of a continuous aquifer unit, perched water was present in the subsurface in discontinuous lenses

As stated above, residual coal fragments were observed on the ground surface along the southwestern edge of the DU. A defined layer of coal fragments was observed in the soil cuttings at CH-MW041 from approximately 0.5 to 1.5 ft bgs; in DU06-S009, DU06-S010, and DU06-S011 from 0.0 to 1.0 ft bgs; in DU06-S013 from 0.0 to 4.0 ft bgs; and in DU06-S014 from 0.0 to 2.0 ft bgs. Trace amounts of residual coal were observed interspersed within the sand at DU06-S015 from 0.0 to 4.5 ft bgs. Additionally, at location DU06-S015, wood debris with petroleum odor was encountered at 4.5 ft bgs. An elevated PID reading of 11.7 ppm was observed at that depth.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 21 June 2017. Groundwater elevations range from 51.44 ft amsl at CH-MW042 to 55.91 ft amsl at CH-MW041 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the southeast towards SEA05.

Groundwater conditions in monitoring wells at DU06 varied between CH-MW041 and CH-MW042 at DU06 (**Table 3-2**). DO concentrations ranged from 1.07 mg/L at CH-MW042 to 5.65 mg/L at CH-MW041; ORP ranged from -32.5 mV at CH-MW042 to 181.1 mV at CH-MW041. Additionally, the pH observed at CH-MW041 was 4.67, which was the lowest pH recorded from all 43 monitoring wells. All other field parameter data (temperature, specific conductance, and turbidity) were comparable to measurements observed in other monitoring wells across Camp Hero State Park. No MNA data were collected from either CH-MW041 or CH-MW042.

Habitat and Ecological Setting

DU06 encompasses a 0.5-acre parcel, which includes a park-maintained lawn with picnic tables and grills. The mowed weedy turf areas are located adjacent to moist woods. Turf areas are dominated by grasses in the *Poaceae* family*,* plantain (*Plantago spp.*), white clover (*Trifolium repens*), and common dandelion (*Taraxacum officinale*). Dominant species outside of the lawn areas include red maple (*A. rubrum*), birch (*Betula* spp.), privet (*Ligustrum* spp.), autumn olive (*Elaeagnus umbellate*), blackberry (*Rubus* spp.), and common reed (*P. australis* ssp. *australis*).

Drainage at the DU is generally towards the west with wet woods, dominated by red maple (A. rubrum), located along a stream channel outside of the DU (SEA05).As mentioned previously, the majority of the SEA05 is revetted; therefore, it was classified as a revetted SEA during the risk assessments. A small portion of SEA05 is present in a southwestern corner of the DU within wetlands located along the southern border of the DU.

4.1.6.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from the former Power Plant (AOC H-11), a former Sewage Ejector Station (AOC H-12), and a tile field associated with the abandoned sitewide WDS (AOC WDS). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included SVOCs (PAHs only), PCBs, and metals (except mercury) in surface soil, subsurface soil, and grab groundwater at the former Power Plant (AOC H-11); VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil, subsurface soil, and grab groundwater at the former Sewage Ejector Station (AOC H-12); and VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil at the tile field (borings WDS-SB23 and WDS-SB24).

Potential site impacts were identified based on the PSE (**Appendix G**) for metals and SVOCs in surface and subsurface soil. VOCs and PCBs did not exceed the preliminary risk screening criteria or BTVs. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU06 for metals and SVOCs in surface and subsurface soil. The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU06. **Exhibit 4-6** provides the progression of the field sampling implemented at DU06. Refer to **Appendix B2** for the full analytical results and **Figure 4-6a** for the sampling locations associated with the Phase III field investigation at DU06.

Exhibit 4-6. DU06 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	**AOC H-12** *Quantity:* 1 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3] **AOC H-11** *Quantity:* 2 *Analyses:* PAHs, PCBs, metals[3]	**AOCs H-12, WDS** *Quantity:* 3 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3] **AOC H-11** *Quantity:* 2 *Analyses:* PAHs, PCBs, metals[3]	**AOCs H-12, WDS** *Quantity:* 3 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3] **AOC H-11** *Quantity:* 2 grab *Analyses:* PAHs, PCBs, metals[3]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	*Quantity:* 2 total & dissolved[6] *Analyses:* metals[4], SVOCs[5]	**SEA05** *Quantity:* 13 Total, 11 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA05** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

6 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface samples were collected from DU06 for metals and SVOC analysis. All metals were detected in surface and subsurface soil at DU06 during the Phase III field investigation in most of the sample locations, with the exception of silver, which was detected in less than half of the surface samples, and antimony, mercury, and silver, which were detected in less than half of the subsurface samples. PAHs were detected in nearly all of the surface and subsurface soil samples. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in surface and subsurface soil samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, arsenic, barium, lead, mercury, thallium, zinc, and several PAHs in surface soil, and arsenic, thallium, and several PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that barium and zinc in surface soil and thallium in subsurface soil were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

As part of the Phase III field investigation, a stream channel passing through a portion of DU06 is included as part of SEA05, which was established to assess potential impacts to surface water and sediment from DU05 and DU06. A total of 14 surface water and 15 sediment samples (locations CH-SWSD096 through CH-SWSD110) were collected from SEA05 for analysis of SVOCs and metals. As mentioned previously, the majority of the SEA05 is revetted; therefore, it was classified as a revetted SEA during the risk assessments.

Section 4.2.5 provides a summary of COPC selection and potential impacts within SEA05, and **Appendix B2** provides tables of all analytical results. Individual PAHs and several PAH totals were identified as COPCs in surface water, and selenium, bis(2-ethylhexyl)phthalate, and two individual PAHs (1-methylnaphthalene and 2-methylnaphthalene) were identified as COPCs in sediment. However, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks, and thus, no COCs were identified in SEA06 surface water or sediment.

Groundwater

Groundwater at DU06 was sampled in two monitoring wells, CH-MW041 and CH-MW042, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 16 metals were detected in total groundwater and 15 metals were detected in the dissolved groundwater fraction. Six individual PAHs were detected in total groundwater from monitoring well CH-MW042; no other SVOCs were detected in total groundwater and no SVOCs were detected in the dissolved fraction. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, total PAHs were retained as a COPC in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU06 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and SVOCs in surface soil, subsurface soil, and groundwater were the only remaining data elements for the Phase III field investigation. As presented in Section 6.0, several metals and PAHs in surface soil and several PAHs in subsurface soil were retained as COPCs. However, the results of the HHRA and ERA concluded that none of the COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs. Total PAHs in total groundwater were identified as a COPC, but did not pose potentially unacceptable risks to humans. Additionally, in the downgradient SEA05, none of the COPCs retained in surface water or sediment posed unacceptable risks to humans or ecological receptors.

No COCs were identified for soil, groundwater, sediment, or surface water located within or downgradient from DU06. Accordingly, per the CERCLA process, no further assessment or response action is warranted for DU06.

4.1.7 DU07: H-19, H-20 AST/Drum Area

4.1.7.1 Overview and Historical CSM

DU07 is a 1-acre DU established to assess potential impacts from a former AST (AOC H-19), a 55-gallon metal drum (AOC H-20), and former boiler (AOC H-9), all of which were discarded on the hillside or along the stream in DU07. Potential environmental impacts were identified based on the presence of these items; however, all items were empty at the time of the RI and their former contents are unknown. The DU boundary encompasses these items, and is bound by Camp Hero Road to the west and an access road to the north. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-7a** for site-specific detail.

During the Phase I RI field investigation, VOCs, SVOCs (PAHs only), and metals were assessed in surface soil at the former AST (AOC H-19); VOCs, SVOCs, PCBs, and metals (except mercury) were assessed in surface and shallow subsurface soil at the drum location (AOC H-20); and SVOCs (PAHs only) and metals (except mercury) were assessed in surface soil at the former boiler (AOC H-9). Based on the PSE, metals in surface and subsurface soil and PAHs in subsurface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Based on the exceedances of PAHs in subsurface soil, surface soil also warranted further evaluation for PAHs. Therefore, unbiased surface and subsurface soil sampling was completed for metals and SVOCs during the Phase III RI field investigation.

During the Phase III event, wetland conditions were observed at DU07 within the state-mapped wetland (Class 1) and additional areas. Avoidance and minimization BMPs included establishing a 100-ft buffer zone around Class 1 state-mapped wetlands, in accordance with article 24 of the NY Freshwater Wetlands Act, and collecting surface and subsurface soil samples remaining within the wetland boundaries using a hand auger instead of a direct push rig. As a result, 8 subsurface soil samples (DU07-S002, DU07-S005, DU07-S006, DU07-S007, DU07-S009, DU07-S010, DU07-S014, and DU07-S015) in the wetland areas were collected from 1 to 2 ft bgs via hand auger, and the remaining 8 samples in non-wetland areas were collected from 1 to 10 ft bgs via direct push.

The Phase III dataset obtained for DU07 includes surface and subsurface soil, as well as groundwater, surface water, and sediment. Surface water and sediment samples were collected from a revetted stream channel that directly transects the DU (represented by SEA01) to assess impacts from DU07, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity, specifically from CH-MW038, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.7.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU07.

Description and Current Use

DU07 is located in the northern portion of Camp Hero State Park, adjacent to the park's baseball fields. The topography of DU07 slopes steeply from northwest to southeast towards the stream channel represented by SEA01. Steep slopes are encountered to the north, west, and south sides of the stream, but the terrain gradually levels off to the east as the stream channel flows into state-mapped wetlands. Land cover on most of DU07 is forested with trees and undergrowth. A park-maintained lawn is located in the southern and western portion of the DU.

Currently, DU07 is undeveloped with limited access due to the steep inclines and wetlands. A baseball field is located to the north of DU07, but a gate along Camp Hero road between DU07 and the baseball field prevents access to DU07. Although Camp Hero Road runs to the west of DU07, vehicles are not permitted to travel the portion of the road between a road block at the intersection with Coast Artillery Road and the gate at the baseball field. While no plans for development or future use directly within DU07 are proposed, the NYSOPRHP has proposed a possible new trail to the north of DU07, originating along an access road to the south of the baseball field and north of DU07.

Geology

The geology of DU07 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-14** depicts the geologic cross section of DU07). One monitoring well was installed (CH-MW038) and subsurface borings advanced within the DU07 boundary. Subsurface soils generally consisted of a silty sand/sandy silt matrix with varying percentages of fine sand and silt. Along the southern side of DU07, the lithology consisted of more continuous units of poorly sorted, medium to coarse sands. Moisture content of the soil in the recovered cuttings was moist to wet starting at 5 ft bgs. Although there was no clear presence of a continuous aquifer unit, perched water was present in the subsurface in discontinuous lenses

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 21 June 2017. The measured groundwater elevation was 57.93 ft amsl at CH-MW038 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the southeast towards the stream represented by SEA01.

Conditions within monitoring well CH-MW038 at DU07 were aerobic. The DO concentration was 4.36 mg/L and ORP was 88.3 mV. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from either CH-MW038.

Habitat and Ecological Setting

DU07 encompasses a 0.5-acre wooded parcel with steep inclines. The mixed hardwood forest is dominated by oak (*Quercus* spp.), American beech (*Fagus grandifolia*), and red maple (*A. rubrum*) with an understory of spicebush (*Lindera benzoin*), privet (*Ligustrum* spp.), American holly (*I. opaca*), and coastal shadbush (*Amelanchier canadensis*). A park-maintained lawn is located in the southern and western portions of the DU. Evidence of deer and wild turkey were observed in the DU.

A revetted stream channel begins in wetlands located at the bottom of the incline in the central-western portion of the DU. The stream channel represents the upstream portion of SEA01 and flows out of the DU to the southeast. Wetland conditions were observed across approximately 30% of the DU and included state-mapped Class 1 wetlands, as well as additional wetland conditions identified during the Phase III field effort.

4.1.7.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a former AST (AOC H-19), a drum location (AOC H-20), and former boiler (AOC H-9). The sampling design consisted of biased sampling in the immediate vicinity of the former AST, drum, and former boiler to target potential source areas. Parameter groups included VOCs, SVOCs (PAHs only), and metals at the former AST (AOC H-19); VOCs, SVOCs, PCBs, and metals (except mercury) in surface and shallow subsurface soil at the drum location (AOC H-20); and SVOCs (PAHs only) and metals (except mercury) in surface soil at the former boiler (AOC H-9).

Potential site impacts were identified based on the PSE (**Appendix G**) for metals and SVOCs in surface and subsurface soil. VOCs and PCBs did not exceed the preliminary risk screening criteria or

BTVs. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU07 for metals and SVOCs in surface and subsurface soil. As described above, wetland conditions were observed within the state-mapped wetland (Class 1) and additional areas. As a result, eight subsurface soil samples within the wetland areas were collected from 1 to 2 ft bgs, and the remaining eight samples outside of wetland areas were collected from 1 to 10 ft bgs.

The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU07. **Exhibit 4-7** provides the progression of the field sampling implemented at DU07. Refer to **Appendix B2** for the full analytical results and **Figure 4-7a** for the sampling locations associated with the Phase III field investigation at DU07.

Exhibit 4-7. DU07 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	**AOC H-20** *Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3] **AOCs H-9, H-19** *Quantity:* 3 *Analyses:* PAHs, metals[3]	**AOC H-20** *Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	*Quantity:* 16 *Analyses:* metals[4], SVOCs[5]	*Quantity:* 1 total & dissolved[6] *Analyses:* metals[4], SVOCs[5]	**SEA01** *Quantity:* 15 Total, 4 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA01** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

6 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface soil samples from DU07 were collected for metals and SVOC analysis. All metals were detected in surface soil at DU07 during the Phase III field investigation in most of the sample locations, with the exception of antimony and silver, which were detected infrequently. In subsurface soil, antimony was not detected and cadmium and silver were detected infrequently; the remaining metals were detected in at least half of the subsurface samples. PAHs were detected in nearly all of the surface and subsurface soil samples collected. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in either surface or subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, lead, zinc, benzoic acid, benzo(b)fluoranthene, pyrene, and total PAHs in surface soil and total PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that zinc was consistent with natural conditions; thus, zinc was eliminated as a surface soil COPC (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

A revetted stream channel begins within wetlands located in DU07 and flows out of the DU to the southeast. As part of the Phase III field investigation, a stream segment was established as SEA01 to assess potential impacts to surface water and sediment from DU07. A total of 15 surface water and 15 sediment samples (locations CH-SWSD031 through CH-SWSD045) were collected from SEA01 for analysis of metals and SVOCs.

Section 4.2.1 provides a summary of COPC selection and potential impacts within SEA01, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in sediment. PAHs were identified as COPCs in surface water. However, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks; thus, no COCs were retained in SEA01 surface water.

Groundwater

Groundwater at DU07 was sampled in one monitoring well, CH-MW038, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 11 metals were detected in total groundwater and nine metals were detected in the dissolved groundwater fraction.

Of the SVOCs, only naphthalene was detected in total groundwater; no SVOCs were detected in the dissolved fraction. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, total PAHs were retained as a COPC in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

<u>Nature and Extent Summary and Potential Risks</u>

The extent of investigation at DU07 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and SVOCs in surface, subsurface soil, and groundwater was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, lead, zinc, benzoic acid, and several PAHs were retained as COPCs in surface soil and PAHs were retained as COPCs in subsurface soil. However, these COPCs did not pose potentially unacceptable risks and no COCs are retained for DU07 soil. Similarly, total PAHs in total groundwater were identified as a COPC, but did not pose potentially unacceptable risks. In the downgradient SEA01, no COPCs were retained in sediment and none of the COPCs retained in surface water posed unacceptable risks to humans or ecological receptors.

No COCs were identified for soil, groundwater, sediment, or surface water located within or downgradient from DU07. Accordingly, per the CERCLA process, no further assessment or response action is warranted for DU07.

4.1.8 DU08: WDS Chlorine Contact Chamber Area

4.1.8.1 Overview and Historical CSM

DU08 is a 0.5-acre DU established to assess potential impacts associated with the abandoned sitewide WDS in the vicinity of the chlorine contact chamber and to the north along the WDS pipeline. The abandoned sitewide WDS was identified during the 2016 historical records search from archive drawings, which indicated that the WDS was connected to a chlorine contact chamber for treatment prior to discharging into the Atlantic Ocean at a headwall outfall. Potential impacts were identified because potential hazardous waste discharges associated with the WDS were suspected.

The DU08 boundary encompasses the chlorine contact chamber and wetland area to the north. It is bound by Old Montauk Highway to the south. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-8a** for site-specific detail.

VOCs, SVOCs, PCBs, and metals were assessed in surface and subsurface soil during the Phase I RI field investigation (as part of the WDS AOC with borings WDS-SB01 to WDS-SB03). Based on the results of the PSE, DU08 warranted further assessment of metals in surface soil and SVOCs in surface and subsurface soil (additional details in the PSE in **Appendix G**). However, wetland conditions were observed within the state-mapped wetland boundary (Class 1) and throughout the entire DU (with the exception of the fill around the contact chamber). Due to the submerged conditions throughout DU08, soil samples could be collected during the Phase III RI field investigation. Instead, surface water and sediment samples were collected from the stream and pond areas within DU08 (represented by SEA08) to represent the appropriate exposure conditions.

The Phase III dataset obtained for DU08 includes surface water and sediment from SEA08, as well as nearby groundwater. Surface water and sediment samples were collected to assess impacts from DU08, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity, specifically from CH-MW036 and CH-MW037, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.8.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU08.

Description and Current Use

DU08 is in the southeastern portion of Camp Hero State Park and is bounded on the southeast by Old Montauk Highway. The DU encompasses the former chlorine contact chamber that was associated with the abandoned sitewide WDS. The topography of DU08 is generally flat with a slight slope to the southeast toward Old Montauk Highway. The DU is covered by thick brush and wetland vegetation, with some trees and undergrowth in the northwest corner. Approximately 90% of DU08 is comprised of palustrine wetlands (aside from the fill materials on which the chlorine contact chamber is built).

During the Phase III RI field investigation, the majority of the DU was submerged, creating a pond on the north side of the chlorine contact chamber. A revetted stream transects the western edge DU from a northeast-southwest direction. The stream and pond were characterized as part of the Phase III field investigation as SEA08. No plans for development or future use are proposed, other than the continued use of the Paumanok Path hiking trail (which is merged with Old Montauk Highway) that follows the coastline to the south of DU08.

Geology

The geology of DU08 is different from many of the other DUs investigated during the RI. Two monitoring wells (CH-MW036 and CH-MW037) were installed just outside of the southern edge of

DU08. Subsurface soils in the vicinity of DU08 generally consisted of well-sorted, medium sands with trace amounts of silt and gravel. Based on observation, the subsurface materials have likely been reworked due to beach processes from their original depositional environment (**Figure 3-19** depicts the geologic cross section of DU08). Moisture content of the soil in the recovered cuttings was wet starting at 5 ft bgs.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 21 and 22 June 2017. The measured groundwater elevation ranged from 12.52 ft amsl at CH-MW036 to 13.21 ft amsl at CH-MW037 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the south towards the beach. The hydraulic connection between SEA08, the delineated wetland, and groundwater is discussed below in Section 4.2.8.

Conditions within monitoring well CH-MW036 and CH-MW037 at DU08 were anaerobic, consistent with typical wetland conditions. DO ranged from 0.07 mg/L at CH-MW037 and 0.31 mg/L at CH-MW036. ORP ranged from -48.9 mV at CH-MW036 and -134.7 mV at CH-MW037. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. MNA parameters were collected from CH-MW037 to support the potential evaluation of remedial alternatives. The data are presented in **Table 3-3**.

Habitat and Ecological Setting

DU08 was identified in the Phase III SAP (AECOM-Tidewater JV 2017c) as a 0.5-acre parcel including terrestrial habitat and a stream channel represented by SEA08. However, at the time of the Phase III sampling, DU08 was submerged and did not represent terrestrial habitat. The Phase III sampling results are evaluated as SEA08 (surface water and sediment) because soil samples were not collected.

Habitat observed during the 2017 field effort included revetted and non-revetted stream channels and inundated wetlands. The primary stream channel flows to the southeast through the DU, under Old Montauk Highway, and into the Atlantic Ocean. The topography in this area indicates the presence of a smaller stream that flows in from the west and joins the primary channel in the western portion of the DU. However, this stream could not be visually identified during the Phase III investigation due to the submerged conditions.

Shrub swamp habitat dominated by highbush blueberry (*V. corymbosum*) and open marsh habitat dominated by common reed (*P. australis ssp. australis*) were both observed. In addition, shrub habitat dominated by autumn olive (*E. umbellate*) and Morrow's honeysuckle (*L. morrowii*) were present in the vicinity of the former chlorine contact chamber. Southern arrowwood (*V. dentatum* *var. venosum*; a state threatened species) was observed along Old Montauk Highway just outside of the DU. Additional palustrine forested wetlands are located to the west-northwest of the DU along the SEA08 stream channel.

4.1.8.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from the abandoned sitewide WDS and associated Chlorine Contact Chamber (AOC WDS; borings WDS-SB01 to WDS-SB03). The sampling design consisted of biased sampling in the immediate vicinity of the chlorine contact chamber to target potential source areas. Parameter groups included VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil, subsurface soil, and grab groundwater around the Chlorine Contact Chamber.

Potential site impacts were identified based on the PSE (**Appendix G**) for metals and SVOCs in surface and subsurface soil. VOCs and PCBs did not exceed the preliminary risk screening criteria or BTVs. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU08 for metals and SVOCs in surface and subsurface soil. However, submerged conditions throughout the entire DU prevented collection of soil samples. Instead, surface water and sediment samples were collected from the stream and pond areas within the DU (represented by SEA08) to represent the appropriate exposure conditions.

The Phase III program also included the collection of nearby groundwater samples to assess potential impacts associated with DU08. **Exhibit 4-8** provides the progression of the field sampling implemented at DU08. Refer to **Appendix B2** for the full analytical results and **Figure 4-8a** for the sampling locations associated with the Phase III field investigation at DU08.

Exhibit 4-8. DU08 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 1 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 3 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--
II	--	--	--	--	--
III	--	--	*Quantity:* 2 total & dissolved[6] *Analyses:* metals[4], SVOCs[5]; MNA[7] in 10%	**SEA08** *Quantity:* 15 Total, 6 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA08** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

6 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

7 MNA parameters were analyzed in 10% of groundwater samples. MNA parameters consisted of biochemical oxygen demand, total oxygen demand, total organic carbon, ferrous iron (field analysis), chlorides, sulfates and sulfides, nitrates and nitrites, alkalinity, methane, ethane, and ethene.

Soil

As discussed above, soil data was not collected during the Phase III sampling event.

Surface Water and Sediment

Surface water and sediment samples, represented by SEA08, were collected within the stream channel passing through DU08 and from within the wetlands/submerged areas to assess potential impacts to surface water and sediment from DU08. A total of 15 surface water and 15 sediment samples (locations CH-SWSD141 through CH-SWSD155) were collected from SEA08 for analysis of metals and SVOCs. As mentioned previously, portions of SEA08 is revetted; however, the majority of the locations were non-revetted, so it was classified as a non-revetted SEA during the risk assessments.

Section 4.2.8 provides a summary of COPC selection and potential impacts within SEA08, and **Appendix B2** provides tables of all analytical results. Cadmium and SVOCs, including PAHs, were identified as COPCs in sediment. No COPCs were identified in surface water. The HHRA concluded that none of the COPCs identified in sediment posed potentially unacceptable risks, and thus, no COCs are identified for human health. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates at SEA08. However, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, further assessment or response action is not warranted for SEA08.

Groundwater

Groundwater at DU08 was sampled in two monitoring wells, CH-MW036 and CH-MW-037, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 18 metals were detected in total groundwater and 14 metals were detected in the dissolved groundwater fraction. Most individual PAHs and dibenzofuran were detected at least once in total groundwater; five individual PAHs and di-n-butyl phthalate were detected in the dissolved fraction. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, aluminum, hexavalent chromium, cobalt, acenaphthene, naphthalene, and dibenzofuran were retained as COPCs in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU08 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and SVOCs in surface soil, subsurface soil, and groundwater were the only remaining data elements for the Phase III field investigation. As discussed above, due to the submerged site conditions, this DU was evaluated using surface water and sediment samples, represented by SEA08, and groundwater collected from two monitoring wells.

No human health COCs were identified in groundwater from DU08 or sediment from SEA08. No human health or ecological COPCs were identified in surface water from SEA08. The ERA indicated that PAHs in sediment at SEA08 could pose unacceptable risks to benthic invertebrates. However, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, no further assessment or response action is warranted for DU08 or SEA08 (Section 4.2.8 includes a detailed discussion of SEA08).

4.1.9 DU09: H-15 Coal Storage Area

4.1.9.1 Overview and Historical CSM

DU09 is a 0.5-acre DU established to assess potential impacts from a former coal storage area (AOC H-15). The DU is located at the eastern boundary of Camp Hero State Park, adjacent to the main entrance. Coal is not currently stored in this area, and residual coal was not observed during the RI field events. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-9a** for site-specific detail.

Potential impacts at DU09 were identified based on its history as a former coal storage area. PAHs and metals were assessed in surface soil during the Phase I RI field investigation; however, only metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, the Phase III RI field investigation was designed to establish an unbiased surface soil sampling grid for metals in surface soil.

The dataset obtained for DU04 includes surface soil. No streams are located in the vicinity of this DU, and groundwater did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.9.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU09.

Description and Current Use

DU09 is located in the eastern portion of Camp Hero State Park. The topography of DU09 is generally flat, with a slight slope to the northeast towards Montauk Point. Land cover at DU09 consists of dense brush, trees, and undergrowth, which limit accessibility to the site. No wetlands or streams are in the vicinity of DU09. Remnants of wire, old fencing, and posts were observed across the southern portion of the DU trending from east-to-west, parallel to an unnamed trail that trends in the same direction at the southern boundary of the DU. No plans for development or future use are proposed, other than the continued use of the Paumanok Path hiking trail that follows the coastline to the east of DU09.

Geology

The geology of DU09 is generally consistent with the sitewide geology characterized in Section 3.2. Neither subsurface soil sampling nor monitoring well installation was conducted within DU09; however, a background monitoring well was installed during the Phase II RI field investigation (CH-MW007) to the southwest of DU09. The composition of the subsurface soil was similar to other locations across the site, but with a higher percentage of fine to medium gravel. The greatest different was the degree of compaction and apparent density which was greater than in any other borings advanced across the site. Additionally, the moisture content of the soil in the recovered cuttings was generally dry, without a clear water-bearing unit within the 0 to 10 ft bgs depth range.

Hydrogeology and Groundwater Conditions

No wells were installed at DU09. However, gauging of the perched groundwater at the nearby background monitoring well CH-MW007 was performed on 14 December 2017. The measured groundwater elevation was 36.12 ft amsl at CH-MW007 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the northeast towards Montauk Point.

Conditions within monitoring well CH-MW007 at DU08 were aerobic. The DO concentration was 8.37 mg/L and the ORP was -4.4 mV. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from CH-MW007.

Habitat and Ecological Setting

DU09 encompasses a densely vegetated 0.5-acre parcel with no stream channels or wetlands. The habitat within the DU includes successional shrub thickets with scattered young trees. Dominant woody species include oak (*Quercus* spp.), wild black cherry (*Prunus serotine*), castal shadbush (*A. canadensis*), bayberry (*Morella pensylvanica*), highbush blueberry (*V. corymbosum*), southern arrowwood (*V. dentatum var. venosum*), privet (*Ligustrum* spp.), American holly (*I. opaca*), Morrow's honeysuckle (*L. morrowii*), common greenbrier (*Smilax rotundifolia*), Japanese honeysuckle (*L. japonica*), oriental bittersweet (*Celastrus orbiculatus*), and grape (*Vitis* spp.). Dominant herbs include common flat-top goldenrod (*Euthamia graminifolia*), garlic mustard (*A. petiolata*), and switch grass (*Panicum virgatum*).

4.1.9.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from former coal storage (AOC H-15). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included PAHs and metals in surface and subsurface soil. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. PAHs in surface soil did not exceed the preliminary risk screening criteria or BTVs. No potential impacts were identified in subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU09 was designed to establish an unbiased sampling grid for metals in surface soil. **Exhibit 4-9** provides the progression of the field sampling implemented at DU09. Refer to **Appendix B2** for the full analytical results and **Figure 4-9a** for the sampling locations associated with the Phase III field investigation at DU09.

Exhibit 4-9. DU09 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 3 *Analyses:* PAHs, metals[1]	*Quantity:* 3 *Analyses:* PAHs, metals[1]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[2]	--	--	--	--

Notes

1 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

2 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil samples.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface soil samples to assess potential site impacts. Further assessment was not required for subsurface soil or other media at DU09. A total of 16 surface soil samples from DU09 were collected for metals analysis. The majority of metals were detected in most of the surface soil samples collected. Antimony and silver were detected in less than half of the samples analyzed. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, lead and mercury were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation did not eliminate lead or mercury as COPCs. The results of the HHRA and ERA concluded that none of the COPCs identified in surface soil posed potentially unacceptable risks, and thus, no COCs were identified for DU09 surface soil.

Surface Water and Sediment

No SEAs are in the vicinity of DU09.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU09. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU09 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, only mercury and lead were retained as surface soil COPCs; however, neither COPC posed potentially unacceptable risks and no COCs were retained for DU09 surface soil. Accordingly, per the CERCLA process, no further assessment or response action is warranted for DU09.

4.1.10 DU10: H-5 Drum/Debris Area

4.1.10.1 Overview and Historical CSM

DU10 is a 0.5-acre DU established to assess potential impacts from former 55-gallon drums and debris area (AOC H-5). It is located in a topographic swale southeast of the Motor Pool Building. The DU boundary is centered on the former drum and debris area and is located within the fence for the Motor Pool. Five drums and construction debris are pictured in the Feasibility Study and Hazardous Materials Survey Preliminary Report for AOC H-5; the former drum contents are unknown (Cashin Associates 1988). However, no evidence of these drums were encountered during the initial site walk conducted on 3 November 2015. The Camp Hero State Park Superintendent

(Mr. Tom Dess) indicated that parks personnel had removed a motorcycle frame and some debris from this area previously. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-10a** for site-specific detail.

Potential impacts at this site were identified based on its history as a former drum and construction debris area. VOCs, SVOCs, PCBs, and metals were assessed in surface and shallow subsurface soil during the Phase I RI field investigation; however, only metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, the Phase III RI field investigation was designed to establish an unbiased surface soil sampling grid for metals in surface soil.

The Phase III dataset obtained for DU10 includes surface soil, surface water, and sediment. A stream channel (represented by SEA03) begins in the central portion of DU10 and flows to the east; surface water and sediment samples were collected from this stream to evaluate impacts from DU10 and to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in the vicinity of DU10 did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.10.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU10.

Description and Current Use

DU10 is located in the north-central portion of Camp Hero on the southern side of Coast Artillery Road, behind the Motor Pool building. The topography in DU10 is generally flat, but includes a gentle swale towards the stream channel represented by SEA03. The natural surface water drainage flows into SEA03, which transects the central part of the study area in a west-to-east direction. No NYSDEC-mapped wetlands are in this area, which is consistent with the absence of wetlands observed during the Phase III field investigation. Land cover at DU10 consists of disturbed semi-open woods, with turf to the north and wet woods to the south, with higher density of low-growing bushes along SEA03. While debris and drums were reported to be present at the time of the 1988 inspection (Cashin Associates 1988), neither debris or drums were visually observed during the RI investigation. DU10 is currently undeveloped with limited access, as it is located behind the locked fence of the Motor Pool building. No plans for development or future use are proposed in this area, aside from park maintenance operations, including storage of equipment, to the north of DU10 at the Motor Pool building.

Geology

The geology of DU10 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-18** depicts the geologic cross section of DU10, DU11 and DU12). Subsurface soil borings or monitoring wells were not required for DU10. Surface soil generally consisted of silt with trace amounts of fine sand. Additionally, the surface soil contained a high percentage of organic material (roots and decayed vegetation). Moisture content was slightly moist.

One monitoring well (CH-MW043) was installed to the northeast of DU10 at the Motor Pool building. Subsurface soils within this monitoring well boring varied widely from poorly graded sands to silt, with trace amounts of subrounded gravel observed. Moisture content of the subsurface soil in the recovered cuttings was moist.

Hydrogeology and Groundwater Conditions

No groundwater monitoring wells were installed within DU10; however, one monitoring well (CH-MW043) was installed to the northeast. Gauging of the perched groundwater was performed on 27 June 2017 and the measured groundwater elevation was 49.19 ft amsl (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction was to the east-northeast, following the flow direction of SEA03.

Conditions within CH-MW043 were aerobic. The DO concentration was 1.01 mg/L and the ORP was 109.7 mv. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. MNA parameters were collected from CH-MW043 and the data are presented in **Table 3-3**.

Habitat and Ecological Setting

DU10 encompasses a 0.5-acre partially-wooded parcel with turf areas located in the northern portion of the DU and wet woods located in the southern portion. The motor pool fence is located along a portion of the western DU boundary and may limit some access to the DU by larger wildlife. The stream channel represented by SEA03 begins in the central portion of the DU and flows to the east. The portion of SEA03 within DU10 was non-revetted; however, revetments were present in the portion of SEA03 within DU11. Drainage across the DU is towards the stream channel. Wetland conditions were not observed in the DU. Dominant woody species include red maple (*A. rubrum*), beech (*Fagus* spp.), white oak (*Q. alba),* American holly (*I. opaca*), and common greenbrier (*S. rotundifolia*) with garlic mustard (*A. petiolata*) in the herbaceous layer.

4.1.10.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from the former drums and construction debris area (AOC H-5). The sampling design consisted of biased sampling in the immediate vicinity of the former drums and construction debris to target potential source areas. Parameter groups included VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil and shallow subsurface soil samples. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. No potential impacts were identified in subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid at DU10 for metals in surface soil. The Phase III program also included the collection of nearby surface water and sediment samples to assess potential impacts associated with DU10. **Exhibit 4-10** provides the progression of the field sampling implemented at DU10. Refer to **Appendix B2** for the full analytical results and **Figure 4-10a** for the sampling locations associated with the Phase III field investigation at DU10.

Exhibit 4-10. DU10 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 4 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 4 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4]	--	--	**SEA03** *Quantity:* 10 Total, 3 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA03** *Quantity:* 14 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface soil samples to assess potential site impacts due to metals. Further assessment was not required for organics or for subsurface soil or other site media. A total of 16 surface soil samples from DU10 were collected for metals analysis. The majority of metals were detected in most of the surface soil samples collected. Thallium was only detected in half of the samples analyzed. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, barium, lead, and mercury were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation did not eliminate lead or mercury as COPCs. The results of the HHRA and ERA concluded that none of the COPCs identified in surface soil posed potentially unacceptable risks, and thus, no COCs were identified for DU10 surface soil.

Surface Water and Sediment

As part of the Phase III field investigation, a stream channel starting within DU10 is included as part of SEA03, which was established to assess potential impacts to surface water and sediment from DU10 and DU11 (located downstream from DU10). A total of 10 surface water and 14 sediment samples (locations CH-SWSD066 through CH-SWSD079) were collected from SEA03 for analysis of SVOCs and metals. Four locations within SEA03 were dry; therefore, surface water samples could not be collected at those locations. As mentioned previously, SEA03 included revetted and non-revetted portions. Field notes indicated that thee majority of SEA03 did not have revetments visible at the time of sampling; therefore, SEA03 was classified as a non-revetted SEA during the risk assessments.

Section 4.2.3 provides a summary of COPC selection and potential impacts within SEA03, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in surface water. 3,4-Methylphenol, benzaldehyde, and several PAHs were identified as COPCs in sediment. The results of the HHRA concluded that no COCs were associated with SEA03 sediment. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates; however, further evaluation of PAHs at SEA03 was conducted to determine whether the PAHs were indicative of a CERCLA release. This further evaluation included reviewing the spatial distribution of total PAHs (discussed in Section 4.2.3), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs in SEA03 (**Appendix C5**). The further evaluation indicated that the PAHs in SEA03 could not be attributed to a CERCLA release.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU10. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU10 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, barium, lead and mercury were retained as surface soil COPCs. However, these COPCs did not pose potentially unacceptable risks and no COCs were retained for DU10 soil. In the downgradient SEA03, no COPCs were retained in surface water and the HHRA concluded that no COCs were associated with SEA03 sediment. Although the ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates in some locations, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, no further assessment or response action warranted for DU10 or SEA03.

4.1.11 DU11: H-16 Sewage, WDS Septic Area

4.1.11.1 Overview and Historical CSM

DU11 is a 1-acre DU established to assess potential impacts from former Building 34 (AOC 034), the former Sewage Treatment Area (AOC H-16), and a drain and cesspool east of the Motor Pool associated with the abandoned sitewide WDS (AOC WDS). The DU boundary encompasses these former operational areas and is bounded by Coast Artillery Road to the north and the Motor Pool fence to the west. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-11a** for site-specific detail.

Potential impacts were identified at this DU based on the construction debris associated with the former Building 34 area, and based on the sewage treatment area and cesspool as potential hazardous waste discharges related to these cesspools were suspected. During the Phase I RI field investigation, SVOCs (PAHs only), PCBs, and metals (except mercury) were assessed in surface soil and subsurface soil at former Building 34 (AOC 034); VOCs, SVOCs, PCBs, and metals (except mercury) were assessed in surface soil and subsurface soil at the former Sewage Treatment Area (AOC H-16); and VOCs, SVOCs, PCBs, and energetics were assessed in surface soil and subsurface soil at Motor Pool drain and cesspool (borings MP-SB02 and MP-SB03).

Based on the results of the PSE, SVOCs and metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, unbiased surface soil sampling was completed for SVOCs and metals during the Phase III RI field investigation.

The Phase III dataset obtained for DU11 includes surface soil, as well as groundwater, surface water, and sediment. Surface water and sediment samples were collected from a stream channel that directly transects the DU (represented by SEA03) to assess impacts from DU11, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in this area, specifically from CH-MW032, CH-MW033, and CH-MW043, was assessed as part of the sitewide network of groundwater monitoring wells. CH-MW043 was installed immediately downgradient of the Motor Pool hydraulic lift, where potential petroleum impacts in groundwater were observed during the Phase I RI field investigation.

4.1.11.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU11.

Description and Current Use

DU11 is located in the central portion of Camp Hero State Park, immediately east of the park Motor Pool building. The topography of DU11 is relatively flat, with a slight slope to the northeast towards the Coast Artillery Road. Surface water drainage flows into SEA03, which diagonally transects DU11 in a southwest-to-northeast direction, then flows into the stream channel represented by SEA02. State-mapped wetlands are not identified within the DU; however, a small area of localized wetlands was observed near the center of the DU during the Phase III field investigation. Land cover is heavily wooded and consists of a dense, mixed hardwood forest. The footprint of former Building 34 is included in the DU11 boundary. A small soil pile and building debris were observed in that area during the field investigations. DU11 is currently undeveloped and no plans for development or future use are proposed in this area.

Geology

The geology of DU11 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-18** depicts the geologic cross section of DU10, DU11 and DU12). Two monitoring wells were installed (CH-MW032 and CH-MW033) within DU11 and one monitoring well was installed (CH-MW043) immediately west of DU11 at the Motor Pool building. Subsurface soils in the vicinity of DU11 varied widely from poorly graded sands to silt. Trace amounts of subrounded gravel were observed in the upgradient CH-MW043 boring. Moisture content of the soil in the recovered cuttings was moist. Although there was no clear presence of a continuous aquifer unit, perched water was present in the subsurface in discontinuous lenses.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 23 June 2017. The measured groundwater elevation was 50.67 ft amsl at CH-MW033 and 59.52 ft amsl at CH-MW032 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the east-northeast, following the flow direction of SEA03.

Conditions within monitoring wells at DU11 were aerobic. The DO concentration ranged from 3.63 mg/L at CH-MW033 to 3.64 mg/L at CH-MW032. ORP ranged from -1.2 at CH-MW032 to 85.6 mV at CH-MW033. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. MNA data were not collected from CH-MW032 or CH-MW033; however, MNA parameters were collected from the upgradient monitoring well CH-MW043. The data are presented in **Table 3-3**.

Habitat and Ecological Setting

DU11 encompasses a 1-acre wooded parcel located just south of Coast Artillery Road. A stream channel (represented by SEA03) flows from the southwestern corner of the DU toward the northeastern corner of the DU and then discharges through a culvert into a southeastern flowing stream channel represented by SEA02. The portion of SEA03 within DU10 was non-revetted; however, revetments were present in the portion of SEA03 within DU11.

Mixed hardwood forests within the DU are dominated by oak (*Quercus* spp.), red maple (*A. rubrum*), sassafras (*S. albidum*), wild black cherry (*P. serotine*), American basswood (*T. americana*), multiflora rose (*R. multiflora*), American holly (*I. opaca*), Morrow's honeysuckle (*L. morrowii*), blackberry (*Rubus* spp.), oriental bittersweet (*C. orbiculatus*), and willow (*Salix* spp.). The herbaceous layer is dominated by garlic mustard (*A. petiolate*), switch grass (*P. virgatum*), and common flat-top goldenrod (*E. graminifolia*). Southern arrowwood (*V. dentatum var. venosum*; a state-threatened species) was observed within the DU.

Wet woods located to the south and east of the DU are dominated by red maple (*A. rubrum*) and American holly (*I. opaca*). A small area of wetlands was observed within the central portion of the DU during the Phase III field effort.

4.1.11.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from former Building 34 (AOC 034), the former Sewage Treatment Area (AOC H-16), and a drain and cesspool east of the Motor Pool (AOC MP) associated with the abandoned sitewide WDS (AOC WDS; location WDS-SB11). The sampling design consisted of biased sampling to target the potential source area. Parameter groups included SVOCs (PAHs only), PCBs, and metals (except mercury) in surface soil, subsurface soil, and grab groundwater at former Building 34 (AOC 034); VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil, subsurface soil, and grab groundwater at the former Sewage Treatment Area and WDS (AOCs H-16 and WDS); VOCs, SVOCs, and energetics in surface soil, subsurface soil, and grab groundwater at Motor Pool drain and cesspool (boring MP-SB02); and VOCs, SVOCs, PCBs, and energetics in surface soil, subsurface soil, and grab groundwater at Motor Pool drain and cesspool (boring MP-SB03).

Potential site impacts were identified based on the PSE (**Appendix G**) for SVOCs and metals in surface soil. Because VOCs, metals, and PCBs did not exceed the preliminary risk screening criteria or BTVs, further sampling of those parameters in soil was not performed. However, potential petroleum impacts were observed in groundwater immediately downgradient of the Motor Pool hydraulic lift during the Phase I RI field investigation; therefore, evaluation of VOCs in groundwater near the hydraulic lift was warranted. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU11 was designed to establish an unbiased sampling grid for SVOCs and metals in surface soil. The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU11. Groundwater at two wells, CH-MW032 and CH-MW043, evaluated VOCs in addition to the sitewide evaluation for SVOCs and metals; potential petroleum impacts were observed in groundwater near CH-MW043 during the Phase I RI field investigation and petroleum odor and an elevated PID reading (19.5 ppm) was measured in the well head at the time of sampling at CH-MW032. **Exhibit 4-11** provides the progression of the field sampling implemented at DU11. Refer to **Appendix B2** for the full analytical results and **Figure 4-11a** for the sampling locations associated with the Phase III field investigation at DU11.

Exhibit 4-11. DU11 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	**AOC H-16** *Quantity:* 1 *Analyses*: VOCs[1], SVOCs[2], PCBs, metals[3] **AOC 034** *Quantity:* 5 *Analyses:* PAHs, PCBs, metals[3] **Location MP-SB02** *Quantity:* 1 *Analyses:* STARS list for fuel oil VOCs and SVOCs[4], energetics **Location MP-SB03** *Quantity:* 1 *Analyses:* STARS list for fuel oil VOCs and SVOCs[4], PCBs, energetics	**AOCs H-16, WDS** *Quantity:* 2 *Analyses*: VOCs[1], SVOCs[2], PCBs, metals[3] **AOC 034** *Quantity:* 5 *Analyses:* PAHs, PCBs, metals[3] **Location MP-SB03** *Quantity:* 1 *Analyses:* STARS list for fuel oil VOCs and SVOCs[4], PCBs, energetics	**AOCs H-16, WDS** Quantity: 2 Analyses: VOCs[1], SVOCs[2], PCBs, metals[3] **AOC 034** Quantity: 1 Analyses: PAHs, PCBs, metals[3] **Location MP-SB02** Quantity: 1 Analyses: VOCs[1], SVOCs[2], energetics **Location MP-SB03** Quantity: 1 Analyses: VOCs[1], SVOCs[2], PCBs, energetics	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[5]	--	*Quantity:* 3 total & dissolved[6] *Analyses:* VOCs[7], SVOCs[8], metals[5]; MNA[9] in 10%	**SEA03** *Quantity:* 10 Total, 3 Dissolved *Analyses:* metals[5], SVOCs[8], hardness	**SEA03** *Quantity:* 14 *Analyses:* metals[5], SVOCs[8], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 For Phase I AOCs with suspected petroleum impacts only, only selected VOCs and SVOCs from the NYSDEC STARS list for fuel oil and/or gasoline were analyzed.

5 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

6 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

7 Phase III VOCs included selected TCL VOCs based on PSE results, plus the NYSDEC STARS list.

8 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

9 MNA parameters were analyzed in 10% of groundwater samples. MNA parameters consisted of biochemical oxygen demand, total oxygen demand, total organic carbon, ferrous iron (field analysis), chlorides, sulfates and sulfides, nitrates and nitrites, alkalinity, methane, ethane, and ethene.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface soil samples to assess potential site impacts. A total of 16 surface soil samples from DU11 were collected for metals and SVOC analysis. All metals were detected in surface soil at DU11 during the Phase III field investigation in most of the sample locations, with the exception of antimony and sodium, which were detected in less than half of the samples. PAHs were detected in all of the surface soil samples collected. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in surface soil samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, barium, cobalt, lead, manganese, mercury, 1,1'-biphenyl, and several PAHs in surface soil and cobalt, manganese, and several PAHs in surface soil evaluated as a surrogate for 'total soil' in the HHRA were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that barium, cobalt, and manganese in surface soil were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA concluded that benzo(a)pyrene in surface soil could pose potential risks for the future on-site construction worker. Additionally, the results of the ERA concluded that total HMW PAHs and total LMW PAHs in surface soil could pose potential risks to terrestrial plants, soil invertebrates, birds, and mammals. However, further evaluation of the PAHs at DU11 was conducted in the uncertainty assessment, including reviewing the spatial distribution of PAHs in surface soil, researching their potential sources, and reviewing the exposure assumptions made in the HHRA and ERA.

Detections of benzo(a)pyrene in surface soil ranged from 0.031 mg/kg to 180 mg/kg, with the maximum detection at DU11-S003. The surface soil EPC for benzo(a)pyrene was strongly influenced by the DU11-S003 concentration of 180 mg/kg, as the remaining concentrations ranged from 0.031 mg/kg to only 1.7 mg/kg. The concentrations of total HMW PAHs ranged from 0.3 mg/kg to 1500 mg/kg, while the concentrations of total LMW PAHs ranged from 0.12 mg/kg to 1600 mg/kg. The maximum detection for both LMW and HMW PAHs was also at location DU11-S003. Location DU11-S003 was placed near the back (south) side of former Building 034. The distributions of benzo(a)pyrene, total HMW PAHs, and total LMW PAHs within DU11 are shown on **Figure 4-11b**. Summary statistics for PAHs are presented in **Table 4-2.** For informational purposes, both individual PAHs and PAH totals are shown.

The results of the additional evaluation indicated that PAHs in surface soil at DU11 were influenced by elevated concentrations of PAHs in a single surface soil sample which may represent creosote or coal tar which would not be associated with a CERCLA release. Based on the distribution of the data and other site-specific uncertainties identified in the HHRA and ERA, benzo(a)pyrene and other PAHs in surface soil were not retained for further evaluation in the HHRA and ERA. Refer to Section 6.3.6 and **Appendix C5** for additional details.

Surface Water and Sediment

As part of the Phase III field investigation, a stream channel passing through DU11 was included as part of SEA03 which was established to assess potential impacts to surface water and sediment from DU10 (located upstream from DU10) and DU11. A total of 10 surface water and 14 sediment samples (locations CH-SWSD066 through CH-SWSD079) were collected from SEA03 for analysis of metals and SVOCs. Four locations within SEA03 were dry; therefore, surface water samples could not be collected at those locations. As mentioned previously, SEA03 included revetted and non-revetted portions and SEA03 was classified as a non-revetted SEA during the risk assessments.

Section 4.2.3 provides a summary of COPC selection and potential impacts within SEA03, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in surface water. 3,4-methylphenol, benzaldehyde, and several PAHs were identified as COPCs in sediment. The results of the HHRA concluded that no COCs were associated with SEA03 sediment. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates in some locations; however, further evaluation of PAHs at SEA03 was conducted to determine whether the PAHs were indicative of a CERCLA release. This further evaluation included reviewing the spatial distribution of total PAHs (discussed in Section 4.2.3), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs in SEA03 (**Appendix C5**). The further evaluation indicated that the PAHs in SEA03 could not be attributed to a CERCLA release..

Groundwater

Groundwater at DU11 was sampled in three monitoring wells, CH-MW032, CH-MW033, and CH-MW043, and analyzed for SVOCs and metals as part of the sitewide groundwater monitoring well network. Additionally, VOCs were analyzed in CH-MW032 and CH-MW043. VOCs were detected in the Phase I grab groundwater sample MP-SB01-GW adjacent to the former hydraulic lift at the Motor Pool; therefore, CH-MW043 was installed during Phase III assess groundwater in the vicinity of observed potential petroleum impacts near the hydraulic lift. At CH-MW032, petroleum odor and an elevated PID reading (19.5 ppm) was measured in the well head at the time of sampling. A total of 17 metals were detected in total groundwater and 16 metals were detected in the dissolved groundwater fraction. Most individual PAHs were detected in total groundwater from monitoring well CH-MW032; several individual PAHs and di-n-butyl phthalate were also detected in the dissolved fraction of groundwater from monitoring well CH-MW032. Pyrene in the dissolved fraction was the only SVOC detected in more than one well. Three VOCs (cis-1,2-dichloroethene, tetrachloroethene, and trichloroethene) were detected in total groundwater. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, cobalt, manganese, tetrachloroethene, and trichloroethene were retained as COPCs in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU11 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and SVOCs in surface soil and groundwater were the only remaining data elements for the Phase III field investigation. As presented in Section 6.0, several metals and SVOCs in surface soil were retained as COPCs. The HHRA and ERA concluded that although PAHs in surface soil at DU11 may pose potentially unacceptable risks to human and ecological receptors, the spatial distribution of SVOCs (i.e., PAHs) in surface soil and a review of the exposure assumptions made in the HHRA and ERA indicate that the risk results are likely overestimated. In addition, a review of the PAH ratios for the DU11-S003 sample indicated that the sample is pyrogenic and may represent creosote or coal tar which would not be associated with a CERCLA release.

Human health COCs were not identified in groundwater and COPCs were not identified in surface water in SEA03. Although the ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates, further evaluation indicated that the PAHs could not be attributed to a

CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, no further assessment or response action is warranted for DU11 or SEA03.

4.1.12 DU12: WDS Manhole Area 1

4.1.12.1 Overview and Historical CSM

DU12 is a 0.5-acre DU established to assess potential impacts from a manhole and a cleanout box associated with the abandoned sitewide WDS. The DU boundary encompasses these features of the WDS and is transected by Coast Artillery Road. An existing concrete foundation from a former building occupies the majority of the DU south of Coast Artillery Road, while a park maintenance and brush storage area occupies the majority of the DU north of Coast Artillery Road. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-12a** for site-specific detail.

Potential impacts were identified at the manhole and cleanout box because potential hazardous waste discharges were suspected at this location. VOCs, SVOCs, PCBs, and metals were assessed in subsurface soil during the Phase I RI field investigation (as part of the WDS AOC with borings WDS-SB08 to WDS-SB09); however, only SVOCs in surface and subsurface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). As such, unbiased surface and subsurface soil sampling was completed for SVOCs during the Phase III RI field investigation.

The Phase III dataset obtained for DU12 includes surface and subsurface soil, as well as groundwater, surface water, and sediment. Surface water and sediment samples were collected from a stream channel that flows through the western portion of the DU (represented by SEA02) to assess impacts from DU12, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in this area, specifically from CH-MW030, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.12.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU12.

Description and Current Use

DU12 is in the north-central portion of Camp Hero along Coast Artillery Road. Surface water drainage flows into the revetted stream channel represented by SEA02, which flows along the southwestern boundary of DU12 in a west-to-east direction. The topography of DU12 is relatively flat, aside from a steep embankment along SEA02. Although NYSDEC-mapped wetlands are shown at the northern edge of DU12, wetlands were not observed during the Phase III RI field investigation.

An existing concrete foundation from a former building occupies the majority of the groundcover south of Coast Artillery Road, while a park maintenance area occupies the majority of the groundcover north of the road. The maintenance area is mostly dirt-covered with intermittent grass and piled brush; it is partially fenced but usually open. The land cover adjacent to SEA02 along the southwestern edge of the DU is densely forested with trees, brush, and undergrowth. Additionally, a large soil berm exists on the eastern side of DU12 along the concrete building foundation. No plans for development or future use are proposed in this area.

Geology

The geology of DU12 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-16** depicts the geologic cross section of DU12 and DU14; **Figure 3-17** depicting the geologic cross section of DU12, DU13, and DU17; and **Figure 3-18** depicting the geologic cross section of DU10, DU11 and DU12). One monitoring well was installed (CH-MW030) and subsurface borings were advanced within DU12. Subsurface soils within DU12 comprised of silty sand with varying percentages of silt and fine sand. Generally, higher percentages of sand were observed within 5 to10 ft bgs interval. Additionally, trace amounts of building material (brick, concrete) were observed in several borings within the 2 to 5 ft bgs interval. Moisture content of the soil in the recovered cuttings varied greatly and was not consistent across the site. Although there was no clear presence of a continuous aquifer unit, perched water was present in the subsurface in discontinuous lenses.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 26 June 2017. The measured groundwater elevation was 43.06 ft amsl at CH-MW033 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the southwest towards SEA02.

Conditions within the monitoring well at DU12 were anaerobic. The DO concentration was 0.28 mg/L and the ORP was -107.4 mV. All other field parameter data (temperature, specific conductance, pH, and turbidity) was comparable to measurements observed in other monitoring wells across the site. MNA data were not collected from CH-MW030.

Habitat and Ecological Setting

DU12 encompasses a 0.5-acre parcel spanning Coast Artillery Road which includes an existing concrete foundation, pavement along the road, an fenced dirt field using as a park maintenance area, and dense woods along the southwestern edge of the DU. A revetted stream channel (represented by SEA02) flows to the southeast along the southwestern portion of the DU. Wetland conditions were not observed in the DU. The developed areas within the DU are unlikely to provide habitat for wildlife.

Habitat along the roadside includes weedy, mowed turf transitioning into mixed hardwood forest. Dominant species include oak (*Quercus* spp.), Norway maple (*A. platanoides*), American basswood (*T. americana*), American holly (*I. opaca*), multiflora rose (*R. multiflora*), coastal sweet pepperbush (*Clethra alnifolia*), highbush blueberry (*V. corymbosum*), Japanese honeysuckle (*L. japonica)*, common greenbrier (*S. rotundifolia)*, common wormwood (*Artemisia vulgaris*), and switch grass (*P. virgatum*).

Scattered southern arrowwood (*V. dentatum var. venosum*; a state threatened species) were observed in the vicinity of the sewer line located to the north of Coast Artillery Road.

4.1.12.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a manhole and a cleanout box associated with the abandoned sitewide WDS (including Phase I borings WDS-SB08 to WDS-SB09). The sampling design consisted of biased sampling to target the potential source area. Parameter groups consisted of VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for SVOCs in surface and subsurface soil. Because VOCs, metals, and PCBs did not exceed the preliminary risk screening criteria or BTVs, no further analysis of those parameters was warranted. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU12 was designed to establish an unbiased sampling grid for SVOCs in surface and subsurface soil. The Phase III program also included the collection of nearby groundwater, surface water, and sediment samples to assess potential impacts associated with DU12. **Exhibit 4-12** provides the progression of the field sampling implemented at DU12. Refer to **Appendix B2** for the full analytical results and **Figure 4-12a** for the sampling locations associated with the Phase III field investigation at DU12.

Exhibit 4-12. DU12 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	--	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* SVOCs[5]	*Quantity:* 16 *Analyses:* SVOCs[5]	*Quantity:* 1 total & dissolved[6] *Analyses:* metals[4], SVOCs[5]	**SEA02** *Quantity:* 20 Total, 0 Dissolved *Analyses:* metals[4],	**SEA02** *Quantity:* 20 *Analyses:* metals[4], SVOCs[5], TOC

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
				SVOCs[5], hardness	

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

6 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface soil samples from DU12 were collected for SVOC analysis. PAHs were detected in nearly all of the surface and subsurface soil samples collected. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in either surface or subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, several PAHs and other SVOCs in surface soil and subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The results of the HHRA indicated that benzo(a)pyrene and total BaP PAHs in surface soil could pose potential risks to the child and adult recreational users. Additionally, the results of the ERA concluded that total HMW PAHs and total LMW PAHs in surface soil could pose potential risks to terrestrial plants, soil invertebrates, birds, and mammals. However, further evaluation of PAHs at DU12 was conducted to determine whether the PAHs were indicative of a CERCLA release. This further evaluation included reviewing the spatial distribution of PAHs in surface soil (as discussed below), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs (**Appendix C5**). The further evaluation indicated that the PAHs in surface soil at DU12 could not be attributed to a CERCLA release.

Concentrations of the PAH totals generally increased with proximity to Coast Artillery Road. The concentrations of benzo(a)pyrene in surface soil at DU12 ranged from 0.043 mg/kg to 150 mg/kg. While some sample locations contribute more to the calculated site risks, the risk assessments were based on the evaluation of EPCs across each DU and SEA per the CERCLA process, rather than solely benchmark comparison (refer to Section 6.0). Three of the 16 surface soil benzo(a)pyrene concentrations at DU12 were above 100 mg/kg (ranging from 110 mg/kg to 150 mg/kg): sample locations DU12-S001, DU12-S004, and DU12-S008. The remaining results ranged from 0.043

mg/kg to 77 mg/kg. The concentrations of total BaP PAHs in surface soil at DU12 ranged from 0.063 mg/kg to 220 mg/kg, and were driven by the concentrations of benzo(a)pyrene. The concentrations of total HMW PAHs in surface soil at DU12 ranged from 0.34 mg/kg to 1300 mg/kg. The concentrations of total LMW PAHs in surface soil ranged at DU12 from 0.16 mg/kg to 1100 mg/kg. The maximum detections of all four PAHs discussed (benzo(a)pyrene, total BaP PAHs, total HMW PAHs, and total LMW PAHs) were found at location DU12-S001; additionally, the maximum detection of total LMW PAHs was detected at the same concentration at location DU12-S008. DU12-S001 was located along the north side of Coast Artillery Road near the entrance to the park maintenance and brush storage area, where vehicles enter and exit the area. Samples from locations DU12-S004 and DU12-S008 were collected near the concrete foundation along the south side of Coast Artillery Road. Additionally, soil boring logs for DU12 indicated evidence of demolished asphalt parking lot materials (**Appendix I**). The distribution of PAHs within DU12 is shown on **Figure 4-12b**. Summary statistics for PAHs are presented in **Table 4-2.** For informational purposes, both individual PAHs and PAH totals are shown.

As shown in **Figure 4-12a**, a former Fueling Station (former Building 36) was previously located to the northwest of DU12. The historical records associated with the former Fueling Station were reviewed during the records review phase of this RI, as documented in **Appendix D**. The USTs associated with the former Building 36 (USTs 24A, 24B, and 25) had an associated NYSDEC spill report, 93-09098, dated 25 October 1993. The spill report was closed later in 1993 with a NYSDEC-Region 1 Tank Removal Report. The USTs/the former fueling station was not investigated during the Phase I RI field program as an AOC because NFA was required by NYSDEC (there were no COCs above regulatory action levels). Although the fueling station was not specifically investigated in this RI, a potential fuel release from the station was considered as a possible source for the high concentrations of PAHs detected within DU12 near the former fueling station. However, the PAH source evaluation conducted as part of the additional characterization of PAHs (**Appendix C5**) indicated the PAHs at DU12 were likely not related to a fuel spill from former Building 36. Rather, the mostly likely sources included non-point sources such as vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance.

Surface Water and Sediment

As part of the Phase III field investigation, a revetted stream channel passing through DU12 is included as part of SEA02. SEA02 was established to assess potential impacts to surface water and sediment from DU17 (located upstream from DU12) and DU12 and which may also be influenced by DU11 and a stream channel entering from the west within DU11 (a portion of which is represented by SEA06). A total of 20 surface water and 20 sediment samples (locations CH-SWSD046 through CH-SWSD065) were collected from SEA02 for analysis of SVOCs and metals.

Section 4.2.2 provides a summary of COPC selection and potential impacts within SEA02, and **Appendix B2** provides tables of all analytical results. COPCs were not identified in surface water and 3,4-methylphenol was retained as a COPC in sediment. The results of the HHRA and ERA concluded that COCs were not identified in surface water or sediment for SEA02.

Groundwater

Groundwater at DU12 was sampled in one monitoring well, CH-MW030, and analyzed for SVOCs and metals as part of the sitewide groundwater monitoring well network, as well as VOCs, because an elevated well head PID reading (19.5 ppm) was measured at the time of sampling. A total of 18 metals were detected in total groundwater and 14 metals were detected in the dissolved groundwater fraction. Most individual PAHs and dibenzofuran were detected in total groundwater; four individual PAHs and di-n-butyl phthalate were detected in the dissolved fraction. Acetone was also detected in total groundwater; no other VOCs were detected in total groundwater or the dissolved fraction. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, aluminum, hexavalent chromium, vanadium, naphthalene, dibenzofuran, total PAHs, and total BaP PAHs were retained as COPCs in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU12 is sufficient to complete the RI phase of the CERCLA process. The potential presence of SVOCs in surface soil and subsurface soil and metals, SVOCs, and VOCs in groundwater were the only remaining data elements for the Phase III field investigation. As presented in Section 6.0, no COCs were identified in groundwater, and no COCs were identified in surface water or sediment in the downgradient SEA02.

Several PAHs and other SVOCs in surface soil were retained as COPCs. The risk assessments indicated that that benzo(a)pyrene and total BaP PAHs in surface soil could pose potential risks to the child and adult recreational users and that total HMW PAHs and total LMW PAHs in surface soil could pose potential risks for terrestrial plants, soil invertebrates, birds, and mammals. However, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, no further assessment or response action is warranted for DU11 or SEA02.

4.1.13 DU13: H-14 Coal Storage Area

4.1.13.1 Overview and Historical CSM

DU13 is a 0.5-acre DU established to assess potential impacts from a former coal storage area (AOC H-14). A park-maintained lawn occupies approximately half of the DU's surface area. An opening in the vegetation along Coast Artillery Road creates an access point to the lawn, and hikers often use the lawn as a shortcut to the Battery 113 trail, which runs south of the DU. Coal is not currently stored in this area; however, coal remnants were observed to the southwest of DU13 during the RI field investigations. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-13a** for site-specific detail.

Potential impacts at this site were identified based on its history as a former coal storage area. PAHs and metals were assessed in surface and subsurface soil during the Phase I RI field investigation; however, only metals exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, the Phase III RI field investigation was designed to establish an unbiased surface soil sampling grid for metals in surface soil.

The Phase III dataset obtained for DU13 includes surface soil, as well as nearby groundwater, surface water, and sediment. Although no streams directly transect this DU, surface water and sediment samples were collected from a nearby stream (represented by locations within SEA04). Those samples were collected to support the sitewide evaluation of metals and SVOCs in surface water and sediment. Groundwater in the vicinity of this area, specifically from CH-MW034 and CH-MW035, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.13.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU13.

Description and Current Use

DU13 is located in the central portion of Camp Hero on the south side of Coast Artillery Road. The topography at DU13 slopes gently to the northeast from a small knob located in the southern portion of the DU. The slope becomes steep along the nearby stream, represented by SEA04. Land cover is predominantly wooded, aside from a park-maintained lawn in the northeast portion of the DU. No NYSDEC mapped wetlands in this area and no wetlands were observed during the Phase III field investigation. Coal and debris were observed within the southwest portion of the DU. Currently, DU13 is used unofficially for access to the Battery 113 hiking trail, which runs to the south of the DU. No plans for development or future use are proposed, aside from the continued use of the nearby hiking trail.

Geology

The geology of DU13 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-17** depicts the geologic cross section of DU12, DU13, and DU17). Two monitoring wells were installed within the DU13 boundary (CH-MW034 and CH-MW035), and the borings consisted generally of a silty sand matrix with interspersed thin lenses of silt and clay and trace amounts of gravel. The composition of the matrix resulted in soils that were compact and medium dense to dense. Moisture content of the soil in the recovered cuttings was wet in places. Although there was no clear presence of a continuous aquifer unit, perched water was present in the subsurface in discontinuous lenses.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 23 June 2017. Groundwater elevations range from 23.30 ft amsl at CH-MW034 to 17.63 ft amsl at CH-MW035 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the southeast towards SEA04 with an approximate horizontal hydraulic gradient (measured parallel to groundwater flow) across DU13 is 0.161. Groundwater movement flows towards SEA04 to the east and SEA02 to the west.

Generally, conditions within monitoring wells CH-MW034 and CH-MW035 at DU13 were observed to be aerobic or oxidized (**Table 3-2**). DO concentrations ranged from 9.51 mg/L to 10.13 mg/L and ORP ranged from 337.7 mV to 356.2 mV. Specific conductance within CH-MW034 and CH-MW035 (191 millisiemens per centimeter [mS/cm] and 94 mS/cm, respectively) were also higher than most readings observed in other monitoring wells across the site. All other field parameter data (temperature, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from CH-MW034 or CH-MW035.

Habitat and Ecological Setting

DU13 encompasses a 0.5-acre parcel located just south of Coast Artillery Road. A south-flowing revetted stream channel (represented by SEA04) is located to the east of the DU and receives overland runoff from the DU. Wetland conditions were not observed within the DU.

Habitat within the DU includes park-maintained lawn and dense successional shrub thickets with scattered young trees. Thickets are dominated by oak (*Quercus* spp.), wild black cherry (*P. serotine*), red maple (*A. rubrum*), mockernut hickory (*Carya tomentosa*), Morrow's honeysuckle (*L. morrowii*), mountain laurel (*Kalmia latifolia*), witch hazel (*Hamamelis virginiana*), Japanese honeysuckle (*L. japonica*), common greenbrier (*S. rotundifolia*), grape (*Vitis* spp.), and southern arrowwood (*V. dentatum var. venosum*). Dominant herbaceous plants in the turf and thicket margins include English plantain (*Plantago lanceolate*), white clover (*Trifolium repens*), switch grass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*).

4.1.13.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from former coal storage (AOC H-14). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included PAHs and metals in surface soil, subsurface soil, and grab groundwater samples. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. PAHs in surface soil did not exceed the preliminary risk screening criteria or BTVs. No potential impacts were identified in subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU13 was designed to establish an unbiased sampling grid for metals in surface soil. The Phase III program also included the collection of nearby groundwater, surface water, and sediment samples to assess potential impacts associated with DU13. **Exhibit 4-13** provides the progression of the field sampling implemented at DU13. Refer to **Appendix B2** for the full analytical results and **Figure 4-13a** for the sampling locations associated with the Phase III field investigation at DU13.

Exhibit 4-13. DU13 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 3 *Analyses:* PAHs, metals[1]	*Quantity:* 3 *Analyses:* PAHs, metals[1]	*Quantity:* 2 grab *Analyses:* PAHs, metals[1]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[2]	--	*Quantity:* 2 total & dissolved[3] *Analyses:* metals[2], SVOCs[4]	**SEA04** *Quantity:* 16 Total, 0 Dissolved *Analyses:* metals[2], SVOCs[4], hardness	**SEA04** *Quantity:* 16 *Analyses:* metals[2], SVOCs[4], TOC

Notes

1 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

2 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil samples.

3 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

4 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARs list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

<u>Soil</u>

As previously noted, potential impacts from metals in surface soil were identified at DU13 based on the Phase I field investigation and the PSE. Potential impacts were not identified from other parameters in surface soil, and no potential impacts were identified from any parameters in subsurface soil. Based on these results, the Phase III field investigation included the collection of 16 surface soil samples for evaluation of metals.

All metals were detected in surface soil at DU13 during the Phase III field investigation in most of the sample locations, with the exception of infrequent detections of antimony, cadmium, and silver. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, only cobalt and mercury were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that cobalt in surface soil was consistent with natural conditions; thus, it was eliminated as a COPC (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

A nearby stream is located to the east of DU13. As part of the Phase III field investigation, a segment of this stream was established as SEA04 to assess potential impacts to surface water and sediment from DU13 and nearby DU14. A total of 15 surface water and 15 sediment samples (locations CH-SWSD080 through CH-SWSD095) were collected from SEA04 for analysis of metals and SVOCs.

Section 4.2.4 provides a summary of COPC selection and potential impacts within SEA04, and **Appendix B2** provides tables of all analytical results. None of the parameters detected in surface water or sediment at SEA04 were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process.

Groundwater

Groundwater at DU13 was sampled in two monitoring wells, CH-MW034 and CH-MW035, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 18 metals were detected in both the dissolved and total groundwater fractions. One SVOC (diethyl phthalate) was detected in the dissolved fraction; three SVOCs (fluorine, phenanthrene, and total PAHs) were detected in the total fraction. The detections of SVOCs in groundwater are not considered to be associated with DU13, as SVOCs were not identified as potential contaminants at that site. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, aluminum, hexavalent chromium, vanadium, and total PAHs were retained as COPCs in total groundwater for the direct contact pathway based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The analytical results and associated COPCs at DU13 are consistent with the CSM for former coal storage on the ground surface. COPCs retained for surface soil (cobalt and mercury) and groundwater (aluminum, hexavalent chromium, vanadium, and total PAHs in total groundwater, and hexavalent chromium in dissolved groundwater), were evaluated for associated risks in the HHRA and/or the ERA. COPCs were not retained in subsurface soil, surface water, or sediment media.

As presented in Section 6.0, the results of the HHRA and ERA concluded that none of the COPCs at DU13 posed potentially unacceptable risks. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU13.

4.1.14 DU14: WDS Septic Tank Area

4.1.14.1 Overview and Historical CSM

DU14 is a 0.5-acre DU established to assess potential impacts from a suspected septic tank associated with the abandoned sitewide WDS. The DU is bound by Coast Artillery Road to the south and a stream (represented by SEA04) to the east. A large underground structure was identified just north of the Coast Artillery Road during the Phase I RI field investigation via magnetometer survey, which is believed to be an existing septic tank. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-14a** for site-specific detail.

Potential impacts were identified at the suspected septic tank as potential hazardous waste discharges related to the former operation of this septic tank were suspected. VOCs, SVOCs, PCBs, and metals were assessed in subsurface soil during the Phase I RI field investigation (as part of the WDS AOC with borings WDS-SB06 to WDS-SB07); however, only SVOCs in surface and subsurface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, unbiased surface and subsurface soil sampling was completed for SVOCs during the Phase III RI field investigation.

The Phase III dataset obtained for DU14 includes surface and subsurface soil, as well as groundwater, surface water, and sediment. Surface water and sediment samples were collected from a stream channel that transects the eastern edge of the DU (represented by SEA04) to assess impacts from DU13 and DU14, as well as to support the sitewide evaluation of SVOCs and metals in surface water and sediment. Groundwater in this area, specifically from CH-MW031, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.14.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU14.

Description and Current Use

DU14 is located in the north-central portion of Camp Hero, north of Coast Artillery Road. The topography of SEA04 slopes from west to east, from a hill extends along the entire western side of DU14 and slopes severely down to the revetted stream channel on the eastern side of DU14. Surface water drainage flows into the revetted stream channel represented by SEA04, which transects the eastern portion of DU14 in a north-to-south direction. No NYSDEC-mapped wetlands were in this area, which is consistent with the absence of wetlands observed during the Phase III RI field investigation. The majority of land cover at DU14 is mixed hardwood forest, densely forested with trees and undergrowth. Along the roadside on the southern edge of the DU, the general habitat is weedy, mowed turf. A large underground structure was identified just north of the road during the Phase I field investigation via magnetometer survey, which is believed to be an existing septic tank associated with the abandoned sitewide WDS. Currently, DU13 is undeveloped with limited access; no plans for development or future use are proposed within the DU, but a potential new trail may run to the east of the DU (**Figure 3-1**).

Geology

The geology of DU14 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-16** depicts the geologic cross section of DU12 and DU14). One monitoring well was installed (CH-MW031) and subsurface borings were advanced within the DU14 boundary. Soils observed within the cuttings were comprised of a higher sand content then observed in other areas. Generally, the interval between 4 to 10 ft bgs was well-sorted and soft (limited compaction/cementation) with some silt. Moisture content of the soil in the recovered cuttings was wet within the same interval across the majority of DU14.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 23 June 2017. The groundwater elevation measured at CH-MW031 was 17.63 ft amsl (**Table 3-2**). Groundwater contours are shown in **Figure 3-3**. Groundwater flow direction is to the southeast towards SEA04, with an approximate horizontal hydraulic gradient (measured parallel to groundwater flow) across DU14 of 0.240.

Generally, conditions within monitoring well CH-MW031at DU14 were anaerobic (**Table 3-2**). The DO concentration was 7.90 mg/L and the ORP was 108.2 mV. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from CH-MW031.

Habitat and Ecological Setting

DU14 encompasses a 0.5-acre parcel located just north of Coast Artillery Road and DU13. A south-flowing, revetted stream channel (represented by SEA04) is located to the east of the DU and receives overland runoff from the DU. Wetland conditions were not observed within the DU.

Habitat along the roadside is similar to DU12 (located to the west) and includes weedy, mowed turf transitioning into mixed hardwood forest, which covers the majority of the DU. Dominant species include oak (*Quercus* spp.), Norway maple (*A. platanoides*), American basswood (*T. americana*), American holly (*I. opaca*), multiflora rose (*R. multiflora*), coastal sweet pepperbush (*C. alnifolia*), highbush blueberry (*V. corymbosum*), Japanese honeysuckle (*L. japonica)*, common greenbrier (*S. rotundifolia)*, common wormwood (*Artemisia vulgaris*), and switch grass (*P. virgatum*).

Scattered southern arrowwood (*V. dentatum var. venosum*; a state threatened species) were observed in the vicinity of the sewer line located to the north of Coast Artillery Road in the southern portion of the DU.

4.1.14.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a suspected septic tank associated with the abandoned sitewide WDS (including Phase I borings WDS-SB06 to WDS-SB07). The sampling design consisted of biased sampling to target the potential source area. Parameter groups consisted of VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for SVOCs in surface and subsurface soil. Because VOCs, metals, and PCBs did not exceed the preliminary risk screening criteria or BTVs, no further sampling of those parameters was performed. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU14 was designed to establish an unbiased sampling grid for SVOCs in surface and subsurface soil. The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU14. **Exhibit 4-14** provides the progression of the field sampling implemented at DU14. Refer to **Appendix B2** for the full analytical results and **Figure 4-14a** for the sampling locations associated with the Phase III field investigation at DU14.

Exhibit 4-14. DU14 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	--	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* SVOCs[4]	*Quantity:* 16 *Analyses:* SVOCs[4]	*Quantity:* 1 total & dissolved[5] *Analyses:* metals[6], SVOCs[4];	**SEA04** *Quantity:* 16 Total, 0 Dissolved *Analyses:* metals[6], SVOCs[4], hardness	**SEA04** *Quantity:* 16 *Analyses:* metals[6], SVOCs[4], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

5 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

6 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface soil samples from DU14 were collected for SVOC analysis. PAHs were detected in nearly all of the surface and subsurface soil samples collected. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in either surface or subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, benzoic acid and several PAHs in surface soil and PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The results of the HHRA and ERA concluded that none of the COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

A nearby stream is located to the east of DU14. As part of the Phase III field investigation, a segment of this stream was established as SEA04 to assess potential impacts to surface water and sediment from DU14 and nearby DU13. A total of 16 surface water and 16 sediment samples (locations CH-SWSD080 through CH-SWSD095) were collected from SEA04 for analysis of metals and SVOCs.

Section 4.2.4 provides a summary of COPC selection and potential impacts within SEA04, and **Appendix B2** provides tables of all analytical results. None of the parameters detected in surface water or sediment at SEA04 were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process.

Groundwater

Groundwater at DU14 was sampled in one monitoring well, CH-MW031, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 20 metals were detected in total groundwater and 21 metals were detected in the dissolved groundwater fraction. Multiple individual PAHs were detected in both the dissolved groundwater fraction and total groundwater. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, aluminum, hexavalent chromium, lead, thallium, vanadium, and total PAHs were retained as COPCs in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU14 is sufficient to complete the RI phase of the CERCLA process. The potential presence of SVOCs in surface soil and subsurface soil and metals and SVOCs in groundwater were the only remaining data elements for the Phase III field investigation. As presented in Section 6.0, benzoic acid and PAHs were retained as surface soil COPCs, and PAHs were retained as COPCs in sub-surface soil. However, these COPCs did not pose potentially unacceptable risks and no COCs were identified for DU14 soil.

In addition, none of the COPCs retained for evaluation in groundwater posed unacceptable risks to humans and no COPCs were identified in surface water or sediment in the nearby SEA04. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU14.

4.1.15 DU15: H-6 Debris Area

4.1.15.1 Overview and Historical CSM

DU15 is a 0.5-acre DU established to assess potential impacts from a construction debris area (AOC H-6). The DU boundary encompasses the debris area and is bound by a steep embankment to the north and a revetted stream (represented by SEA07) to the south. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-15a** for site-specific detail.

Potential impacts at this site were identified based on its history as a construction debris area. Lead and PCBs were assessed in surface soil during the Phase I RI field investigation; lead in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). The presence of lead in excess of screening criteria and BTVs could be an indication that other metals (not analyzed during Phase I) could pose potential environmental impacts. Additionally, the PCB congener Arochlor-1254 was detected in shallow groundwater in a turbid grab groundwater sample, which could indicate potential PCBs in surface or subsurface soil. Therefore, the Phase III RI field investigation was designed to establish an unbiased sampling grid for metals in surface soil and PCBs in surface and subsurface soil.

During the Phase III event, wetland conditions were observed at DU15 within the state-mapped wetland (Class 1) and additional areas. Avoidance and minimization BMPs included establishing a 100 ft buffer zone around Class 1 state-mapped wetlands, in accordance with article 24 of the NY Freshwater Wetlands Act, and collecting surface and subsurface soil samples remaining within the wetland boundaries using a hand auger instead of a direct push rig. As a result, all subsurface soil samples at DU15 were collected from 1 to 2 ft bgs via hand auger.

The Phase III dataset obtained for DU15 includes surface and subsurface soil, as well as nearby groundwater, surface water, and sediment. Surface water and sediment samples were collected from a revetted stream channel (SEA07) located to the south of the DU to assess impacts from DU15, as well as to support the sitewide evaluation of surface water and sediment. Groundwater in this area, specifically from CH-MW039 and CH-MW040, was assessed as part of the sitewide network of groundwater monitoring wells. Groundwater, surface water, and sediment samples were analyzed for SVOCs, PCBs, and metals.

4.1.15.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU15.

Description and Current Use

DU15 is located in the north-central portion of Camp Hero immediately west of the intersection of Coast Artillery Road and Camp Hero Road. The topography at DU15 slopes from northeast to southwest, with a steep include a small plateau in the northern portion of the DU. Surface water drainage flows southwest towards the stream channel represented by SEA07, which flows in a southeast to northwest direction. The southern half of the DU is classified as NYSDEC Class 1 wetlands; these Class 1 wetlands and additional wetlands within the DU were observed during the

Phase III field investigation. An estimated 50% of the DU is within the wetland. Currently, DU15 is undeveloped with limited access. Existing asphalt paving and a former building foundation are located east of DU15 along Camp Hero Road. No plans for development or future use are proposed in this area.

Geology

The geology of DU15 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-13** depicts the geologic cross section of DU15). Two monitoring wells were installed (CH-MW039 and CH-MW040) within or adjacent to the DU15 boundary. Additionally, surface and shallow subsurface soil samples (1 to 2 ft bgs) were collected via hand auger. (Soil borings could not be conducted within the 100-foot buffer zone of the NYSDEC Class 1 wetland located at the DU). Soils observed within the cuttings were comprised of medium dense silty sand within the 0 to 6 ft bgs interval. Below that depth, the percentage of fine to medium sand increased and transitioned to poorly graded sand at approximately 6 to 7 ft bgs. Moisture content of the soil in the recovered cuttings was dry to moist at the surface, transitioning to wet at approximately 8 to 9 ft bgs.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 21 June 2017. The groundwater elevations ranged from 62.84 ft amsl at CH-MW039 to 63.46 ft amsl at CH-MW040 (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the west in the general direction of flow in SEA07.

Generally, conditions within monitoring wells CH-MW039 and CH-MW040 were aerobic (**Table 3-2**). The DO concentration ranged from 2.96 mg/L at CH-MW039 to 7.01 mg/L at CH-MW040. The ORP concentration ranged from 113.3 mV at CH-MW040 to 134.2 mV at CH-MW039. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from either monitoring well at DU15.

Habitat and Ecological Setting

DU15 encompasses a 0.5-acre parcel, which includes wooded wetlands with mixed hardwood forest. A revetted stream channel (represented by SEA07) is located to the south-southwest of the DU and receives drainage from the DU. Wetlands were present across approximately 50% of the DU during the Phase III sampling effort. Evidence of deer and wild turkey were observed within the DU.

Mixed hardwood forests in the DU are dominated by oak (*Quercus* spp.), sassafras (*Sassafras albidum*), red maple (*A. rubrum*), birch (*Betula* spp.), privet (*Ligustrum* spp.), blackberry (*Rubus* spp.), Morrow's honeysuckle (*L. morrowii*), Japanese barberry (Berberis thunbergii), American holly

(*I. opaca*), wild black cherry (*P. serotine*), coastal sweet pepperbush (*C. alnifolia*), Japanese honeysuckle (*L. japonica)*, common greenbrier (*S. rotundifolia*), oriental bittersweet (*C. orbiculatus*), and grape (Vitis spp.).

4.1.15.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a construction debris area (AOC H-6). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included PCBs and metals in surface soil and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for lead in surface soil. The presence of lead in excess of screening criteria and BTVs could be an indication that other metals (not analyzed during Phase I) could pose potential environmental impacts as well.

Although PCBs in surface soil did not exceed the preliminary risk screening criteria or BTVs, the PCB congener Arochlor-1254 was detected in shallow groundwater in a turbid grab groundwater sample, which could indicate potential PCBs in surface or subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU15 was designed to establish an unbiased sampling grid metals in surface soil and PCBs in surface and subsurface soil. As described above, wetland conditions were observed within the state mapped wetland (Class 1) and additional areas, and all subsurface soil samples were collected from 1 to 2 ft bgs. The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU15. **Exhibit 4-15** provides the progression of the field sampling implemented at DU15. Refer to **Appendix B2** for the full analytical results and **Figure 4-15a** for the sampling locations associated with the Phase III field investigation at DU15.

Exhibit 4-15. DU15 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 3 *Analyses:* PCBs, metals[1]	--	*Quantity:* 3 grab *Analyses:* PCBs, metals[1]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* PCBs, metals[2]	*Quantity:* 16 *Analyses:* PCBs	*Quantity:* 2 total & dissolved[3] *Analyses:* metals[2], PCBs, SVOCs[4]	**SEA07** *Quantity:* 15 Total, 0 Dissolved *Analyses:* metals[2], SVOCs[4], hardness	**SEA07** *Quantity:* 15 *Analyses:* metals[2], SVOCs[4], TOC

Notes

1 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

2 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

3 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

4 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface soil samples from DU15 were collected. Surface soil samples were analyzed for metals and PCBs; subsurface samples were analyzed for PCBs only.

All metals were detected in surface soil at DU15 during the Phase III field investigation in most of the sample locations, with the exception of antimony, which were detected in less than half of the samples. A single PCB Aroclor (Aroclor 1260) was detected in one surface soil sample. PCBs were not detected in any subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, lead, mercury, zinc, and total PCBs in surface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. COPCs were not identified in subsurface soil. The geochemical evaluation indicated that zinc in surface soil was consistent with natural conditions; thus, zinc was eliminated as a surface soil COPC. The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

As part of the Phase III field investigation, a revetted stream channel to the south of DU15 was established as SEA07 to assess potential impacts to surface water and sediment from DU15. A total of 15 surface water and 15 sediment samples (locations CH-SWSD126 through CH-SWSD140) were collected from SEA07 for analysis of metals, SVOCs, and PCBs.

Section 4.2.7 provides a summary of COPC selection and potential impacts within SEA07, and **Appendix B2** provides tables of all analytical results. Total LMW PAHs were identified as COPCs in surface water and PAHs and PCBs were identified as COPCs in sediment. The results of the HHRA and the ERA concluded that no COCs were associated with SEA07 surface water or sediment.

Groundwater

Groundwater at DU15 was sampled in two monitoring wells, CH-MW039 and CH-MW040, and analyzed for SVOCs and metals as part of the sitewide groundwater monitoring well network. Additionally, samples from these two wells were analyzed for PCBs based on the detection of PCBs in a Phase I grab groundwater sample. A total of 15 metals were detected in both the dissolved and total groundwater fractions. Four SVOCs (anthracene, naphthalene, total LMW PAHs, and total PAHs) were detected or calculated in total groundwater; no SVOCs were detected in the dissolved fraction. PCB Aroclors were not detected in the dissolved fraction or in total groundwater. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, total PAHs were retained as a COPC in total groundwater for the direct contact pathway, based on the background evaluation and initial HHRA risk screening process. The results of the HHRA concluded that none of the COPCs identified in groundwater posed potentially unacceptable risks, and thus, none were identified as COCs.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU15 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals and PCBs in surface soil, PCBs in subsurface soil, and metals, SVOCs and PCBs groundwater were evaluated in the Phase III field investigation. As presented in Section 6.0, lead, mercury, zinc, and total PCBs were retained as surface soil COPCs and no COPCs were retained for subsurface soil. The surface soil COPCs did not pose potentially unacceptable risks and no COCs are retained for DU15 surface soil. Similarly, total PAHs in total groundwater were identified as a COPC, but did not pose potentially unacceptable risks. In the downgradient SEA07, unacceptable risks were not identified for any of the surface water or sediment COPCs evaluated in the HHRA or the ERA.

COCs were not identified for soil, groundwater, sediment, or surface water located within or downgradient from DU15. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU15.

4.1.16 DU16: WDS Manhole Area 2

4.1.16.1 Overview and Historical CSM

DU16 is a 0.5-acre DU established to assess potential impacts associated with the abandoned sitewide WDS near a manhole. The DU boundary encompasses the manhole and is bound by roads to the west (Camp Hero Road) and south (Coast Artillery Road). Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-16a** for site-specific detail.

Potential impacts were identified at the manhole of the WDS as potential hazardous waste discharges were suspected. VOCs, SVOCs, PCBs, and metals were assessed in subsurface soil during the Phase I RI field investigation (as part of the WDS AOC with boring WDS-SB13); however, only SVOCs in subsurface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Presence of SVOCs in subsurface soil could be an indication that SVOCs in surface soil may also pose an environmental concern. Therefore, unbiased surface and subsurface soil sampling was completed for SVOCs during the Phase III RI field investigation.

The dataset obtained for DU04 includes surface and subsurface soil. No streams were located in the vicinity of this DU, and groundwater did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.16.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU16.

Description and Current Use

DU16 is located in the north-central portion of Camp Hero, to the northeast of the intersection of Camp Hero Road and Coast Artillery Road. The topography at DU16 is relatively flat, with a mild slope from southwest to northeast. Although no state-mapped wetlands are in the DU, small local wetlands were observed in the northwest and north-central portion of the DU. No streams are in the near vicinity of DU16, but surface water drainage appears to flow into the small wetlands to the north. Land cover at DU16 is thinly forested with trees and undergrowth. An existing concrete foundation from a former building is located in the central portion of DU16. DU16 is currently undeveloped with limited access; however, the NYSOPRPH has proposed a possible future camping area to the east of DU16.

Geology

The geology of DU16 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-15** depicts the geologic cross section of DU16 and DU17). No monitoring wells were installed at DU16; however, subsurface borings were advanced within the DU16 boundary. Soils observed within the cuttings were inconsistent within the top 10 ft bgs. Generally, soils were comprised of tight silty sand matrix with interspersed layers of fine sand and clay or consistent units of fine to medium sand with thin layers of silt and clay. Moisture content ranged from dry to wet and was not observed at a consistent elevation across DU16.

Hydrogeology and Groundwater Conditions

No monitoring wells were installed within DU16; however, background well CH-MW012 was located nearby DU16 to the northwest. Gauging of the perched groundwater at CH-MW012 was performed

on
13 December 2016. The groundwater elevation was 60.82 ft amsl (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the east and the approximate horizontal hydraulic gradient (measured parallel to groundwater flow) across DU16 was 0.080.

Habitat and Ecological Setting

DU16 encompasses a 0.5-acre parcel located just north of Coast Artillery Road and east of Camp Hero Road. Major drainage flows are not apparent, but small areas of wetland conditions were observed in the northern portion of the DU during the Phase III field effort.

Habitat along the roadside is similar to DU12 and DU14 located to the east along Coast Artillery Road and includes weedy, mowed turf, which transitions into mixed hardwood forest throughout the majority of the DU. Dominant species include oak (*Quercus* spp.), Norway maple (*A. platanoides*), American basswood (*T. americana*), American holly (*I. opaca*), multiflora rose (*R. multiflora*), coastal sweet pepperbush (*C. alnifolia*), highbush blueberry (*V. corymbosum*), Japanese honeysuckle (*L. japonica)*, common greenbrier (*S. rotundifolia)*, common wormwood (*Artemisia vulgaris*), and switch grass (*P. virgatum*).

Scattered southern arrowwood (*V. dentatum var. venosum*; a state threatened species) were observed in the vicinity of the sewer line located to the north of Coast Artillery Road in the southern portion of the DU.

4.1.16.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a manhole associated with the abandoned sitewide WDS (including Phase I boring WDS-SB13). The sampling design consisted of biased sampling to target the potential source area. Parameter groups consisted of VOCs, SVOCs, PCBs, and metals (except mercury) in subsurface soil and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for SVOCs in surface and subsurface soil. Because VOCs, metals, and PCBs did not exceed the preliminary risk screening criteria or BTVs, further sampling of those parameters was not performed. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU16 was designed to establish an unbiased sampling grid for SVOCs in surface and subsurface soil. **Exhibit 4-16** provides the progression of the field sampling implemented at DU16. Refer to **Appendix B2** for the full analytical results and **Figure 4-16a** for the sampling locations associated with the Phase III field investigation at DU16.

Exhibit 4-16. DU16 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	--	*Quantity:* 1 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 1 grab *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* SVOCs[4]	*Quantity:* 16 *Analyses:* SVOCs[4]	--	--	--

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Based on the Phase I field investigation and the PSE, the Phase III field investigation included the collection of additional surface and subsurface soil samples to assess potential site impacts. A total of 16 surface soil samples and 16 subsurface soil samples from DU16 were collected for SVOC analysis. PAHs were detected in nearly all of the surface soil samples collected but detected less frequently in the subsurface samples. Phthalates and other SVOCs were typically not detected, or were detected very infrequently, in either surface or subsurface samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, benzoic acid and several PAHs in surface soil and total PAHs in subsurface soil were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The results of the HHRA and ERA concluded that none of the COPCs identified in surface or subsurface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

SEAs are not located in the vicinity of DU16.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU16. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU16 is sufficient to complete the RI phase of the CERCLA process. The potential presence of SVOCs in surface and subsurface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, benzoic acid and several PAHs were retained as surface soil COPCs and PAHs were retained as COPCs in subsurface soil. However, these COPCs did not pose potentially unacceptable risks and no COCs are retained for DU16. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU16.

4.1.17 DU17: H-4 Debris Area

4.1.17.1 Overview and Historical CSM

DU17 is a 0.5-acre DU established to assess potential impacts from a construction debris area (AOC H-4). The DU boundary encompasses the debris area and is bound by on the south by a fenced concrete foundation used as a maintenance and storage area by Camp Hero State Park. A stream (represented by SEA02) transects the northeast corner of the DU, flowing from northwest to southeast. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-17a** for site-specific detail.

Potential impacts at this site were identified based on its history as a construction debris area. Lead and PCBs were assessed in surface soil during the Phase I RI field investigation; lead in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). The presence of lead in excess of screening criteria and BTVs could be an indication that other metals (not analyzed during Phase I) could pose potential environmental impacts. Therefore, the Phase III RI field investigation was designed to establish an unbiased sampling grid for metals in surface soil.

The Phase III dataset obtained for DU17 includes surface soil, as well as nearby groundwater, surface water, and sediment. Surface water and sediment samples were collected from SEA02 to assess impacts from DU17, as well as to support the sitewide evaluation of surface water and sediment. Groundwater in this area, specifically from CH-MW029, was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.17.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU17.

Description and Current Use

DU17 is located in the north-central portion of Camp Hero, north of Coast Artillery Road and the State Park maintenance and storage area. The topography DU17 gently slopes from southwest to northeast. Although no NYSDEC-mapped wetlands are in DU17, local wetlands were observed in the northeastern portion of the DU, encompassing an estimated 30% of the study area. A revetted stream channel, represented by SEA02, transects the northeast corner of DU17 and flows in a northwest-to-southeast direction. Land cover at DU17 is thinly forested with trees, undergrowth, and bushes. DU17 is currently undeveloped with limited access. While no plans for development or future use are proposed directly within this DU, the NYSOPRPH proposed plans for development include a possible future camping area directly to the west of this area.

Geology

The geology of DU17 is generally consistent with the sitewide geology characterized in Section 3.2 (**Figure 3-15** depicts the geologic cross section of DU16 and DU17 and **Figure 3-17** depicting the geologic cross section of DU12, DU13, and DU17). One monitoring well was installed (CH-MW029) at DU17. Surface soils observed during surficial sampling consisted of silt, silty sand, and organic material. Subsurface soils observed in soil cuttings from the monitoring well installation generally consisted of a silty sand/sand matrix with interspersed thin lenses of silt and clay and trace amounts of gravel. Moisture content was moist to 15 ft bgs and transitioned to wet.

Hydrogeology and Groundwater Conditions

Gauging of the perched groundwater was performed on 22 June 2017. The groundwater elevation measured was 44.68 ft amsl (**Table 3-2**). Groundwater contours are shown on **Figure 3-3**. Groundwater flow direction is to the east.

Generally, conditions within monitoring well CH-MW029 were aerobic (**Table 3-2**). The DO concentration was 6.37 mg/L and the ORP was 106 mV. All other field parameter data (temperature, specific conductance, pH, and turbidity) were comparable to measurements observed in other monitoring wells across the site. No MNA data were collected from CH-MW029.

Habitat and Ecological Setting

DU17 encompasses a 0.5-acre wooded parcel located north of Coast Artillery Road. A small revetted stream channel (represented by a portion of SEA02) crosses the northeast corner of the DU and flows to the southeast. Wetland conditions were observed at the stream, extending to the southwest toward the center of the DU.

The mixed hardwood forest in the DU is dominated by oak (*Quercus* spp.), red maple (*A. rubrum),* sassafras (*S. albidum*), mockernut hickory (*C. tomentosa*), and wild black cherry (*P. serotine*). The shrub layer is dominated by American holly (*I. opaca*), Morrow's honeysuckle (*L. morrowii*), highbush blueberry (*V. corymbosum),* autumn olive (*E. umbellate*), oriental bittersweet (*C. orbiculatus)*, Japanese honeysuckle (*L. japonica*), common greenbrier (*S. rotundifolia)*, grape (*Vitis* spp.), witch hazel (*H. virginiana*). The herbaceous layer is dominated by hay-scented fern (*Dennstaedtia punctilobula*) and common reed (*P. australis ssp. australis*).

4.1.17.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from a construction debris area (AOC H-4). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included PCBs and metals in surface soil, subsurface soil, and grab groundwater. Potential site impacts were identified based on the PSE (**Appendix G**) for lead in surface soil. The presence of lead in excess of screening criteria and BTVs could be an indication that other metals (not analyzed during Phase I) could pose potential environmental impacts as well. PCBs were not detected in any media. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation at DU17 was designed to establish an unbiased sampling grid metals in surface soil. The Phase III program also included the collection of groundwater, surface water, and sediment samples to assess potential impacts associated with DU17. **Exhibit 4-17** provides the progression of the field sampling implemented at DU17. Refer to **Appendix B2** for the full analytical results and **Figure 4-17a** for the sampling locations associated with the Phase III field investigation.

Exhibit 4-17. DU17 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 2 *Analyses:* PCBs, metals[1]	*Quantity:* 3 *Analyses:* PCBs, metals[1]	*Quantity:* 3 grab *Analyses:* PCBs, metals[1]	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[2]	--	*Quantity:* 1 total & dissolved[3] *Analyses:* metals[2], SVOCs[4]	**SEA02** *Quantity:* 20 Total, 0 Dissolved *Analyses:* metals[2], SVOCs[4], hardness	**SEA02** *Quantity:* 20 *Analyses:* metals[2], SVOCs[4], TOC

Notes

1 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

2 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

3 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

4 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Potential impacts from metals in surface soil were identified at DU17 based on the Phase I field investigation and the PSE. Potential impacts were not identified from other parameters in surface soil, and no potential impacts were identified from any parameters in subsurface soil. Based on these results, the Phase III field investigation included the collection of 16 surface soil samples for evaluation of metals.

All metals were detected in surface soil at DU17 during the Phase III field investigation in most of the sample locations. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, lead, mercury, and zinc were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that zinc was consistent with natural conditions; thus, zinc was eliminated as a COPC. The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface soil posed potentially unacceptable risks, and thus, none were retained as COCs.

Surface Water and Sediment

As part of the Phase III field investigation, a revetted stream channel passing through DU17 is included as part of SEA02. SEA02 was established to assess potential impacts to surface water and sediment from DU17 and DU12 (located downstream from DU17). SEA02 may also be influenced by DU11 and a stream channel entering from the west (represented by SEA03, which is partially-revetted). A total of 20 surface water and 20 sediment samples (locations CH-SWSD046 through CH-SWSD065) were collected from SEA02 for analysis of SVOCs and metals.

Section 4.2.2 provides a summary of COPC selection and potential impacts within SEA02, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in surface water and 3,4-methylphenol was retained as a COPC in sediment. However, the results of the HHRA and ERA concluded that COCs were not identified in surface water or sediment for SEA02.

Groundwater

Groundwater at DU17 was sampled in one monitoring wells, CH-MW029, and analyzed for metals and SVOCs as part of the sitewide groundwater monitoring well network. A total of 10 metals were detected in the dissolved phase fraction and 11 metals were detected in total groundwater. No SVOCs were detected in either the dissolved phase fraction or total groundwater.

As presented in Section 6.0, no COPCs were retained based on the background evaluation and initial HHRA risk screening process.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU17 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, only three metals were retained as surface soil COPCs based on the background evaluation and initial HHRA and ERA risk screening process. However, these COPCs did not pose potentially unacceptable risks and surface soil COCs were not identified for DU17.

In addition, none of the COPCs retained for evaluation in the nearby SEA02 posed unacceptable risks to humans or ecological receptors and COPCs were not identified in groundwater. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU17.

4.1.18 DU18: H-3 Drum Area

4.1.18.1 Overview and Historical CSM

DU18 is a 0.5-acre DU established to assess potential impacts from potential drum contents (AOC H-3). The DU18 boundary encompasses an existing drum remnant in the woods north of Coast Artillery Road; the former drum contents are unknown. Refer to **Figure 2-4** for the location of this DU within Camp Hero and **Figure 4-18a** for site-specific detail. VOCs, SVOCs, PCBs, and metals were assessed in surface and shallow subsurface soil during the Phase I RI field investigation; however, only metals in surface soil exceeded preliminary risk screening criteria and BTVs (additional details in the PSE in **Appendix G**). Therefore, unbiased surface soil sampling was completed for metals during the Phase III RI field investigation.

The dataset obtained for DU18 includes surface soil. No streams directly transect this DU; however, an upgradient stream segment (represented by SEA01) was assessed for potential impacts from DU07. Since SEA01 is upstream of DU18, the SEA01 data do not incorporate DU18 impacts but are generally expected to represent conditions adjacent to DU18 for the purposes of evaluating combined media exposures at DU18. Groundwater at DU18 did not warrant further evaluation based on the PSE. However, groundwater was assessed as part of the sitewide network of groundwater monitoring wells.

4.1.18.2 Physical Characteristics

A sitewide discussion of the geology, hydrogeology, and physical setting of Camp Hero is provided in Section 3.0. This subsection focuses on additional details specifically associated with DU18.

Description and Current Use

DU18 is located in the north-central portion of Camp Hero, north of Coast Artillery Road. The topography of DU18 slopes from north to south, with a steep grade in the central portion of DU18.

A southeasterly-flowing revetted stream channel (represented by SEA01) is located to the southwest of the DU. A portion of SEA01 was characterized upstream of DU18. Surface water flow is generally to the south, towards the stream channel. Although NYSDEC-mapped wetlands are in the southern portion of the DU, the wetlands were not observed during the Phase III field investigation. Land cover at DU18 is densely forested with trees and undergrowth. An existing weathered 55-gallon drum is located in the center of the DU. DU18 is currently undeveloped with limited access; no plans for development or future use are proposed.

Geology

The geology of DU018 is generally consistent with the sitewide geology characterized in Section 3.2. No subsurface soil borings or monitoring wells were advanced within DU18. Surface soil samples (0 to 1 ft bgs) were collected via hand auger. Surface soil generally consisted of a silty sand matrix with interspersed thin lenses of silt and clay. Additionally, the surface soil contained a high percentage of organic material (roots and decayed vegetation). Moisture content at the near-surface was dry.

Hydrogeology and Groundwater Conditions

No groundwater monitoring wells were installed within or near DU18; however, localized groundwater contours were approximated and are shown on **Figure 3-3**. Groundwater flow direction is southwest.

Habitat and Ecological Setting

DU18 encompasses a 0.5-acre wooded parcel located to the northwest of a southeasterly-flowing revetted stream channel. SEA01 is located in the stream channel just upstream of DU18. Although state-mapped wetlands were identified within the DU along the stream channel, they were not observed during the Phase III field effort. Surface water drainage is generally to the south down an incline towards the stream channel.

The mixed hardwood forest in the DU contains oak (*Quercus* spp.), sassafras (*S. albidum*), mockernut hickory (*C. tomentosa*), mountain laurel (*K. latifolia*), American holly (*I. opaca*), witch hazel (*H. virginiana*), highbush blueberry (*V. corymbosum*), coastal shadbush (*A. canadensis*), and common greenbrier (*S. rotundifolia*).

4.1.18.3 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from an existing drum (AOC H-3). The sampling design consisted of biased sampling to target potential source areas. Parameter groups included VOCs, SVOCs, PCBs, and metals (except mercury) in surface soil and shallow subsurface soil samples. Potential site impacts were identified based on the PSE (**Appendix G**) for metals in surface soil. No potential impacts were identified in subsurface soil. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

The Phase III RI field investigation was designed to establish an unbiased sampling grid for metals in surface soil. **Exhibit 4-18** provides the progression of the field sampling implemented at DU18. Refer to **Appendix B2** for the full analytical results and **Figure 4-18a** for the sampling locations associated with the Phase III field investigation.

Exhibit 4-18. DU18 Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	*Quantity:* 2 *Analyses:* VOCs[1], SVOCs[2], PCBs, metals[3]	--	--	--
II	--	--	--	--	--
III	*Quantity:* 16 *Analyses:* metals[4]	--	--	**SEA01** *Quantity:* 15 Total, 4 Dissolved *Analyses:* metals[4], SVOCs[5], hardness	**SEA01** *Quantity:* 15 *Analyses:* metals[4], SVOCs[5], TOC

Notes

1 Phase I VOCs included the full TCL for VOCs.

2 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

3 Phase I metals included the full TAL metals except mercury. Hexavalent chromium analysis was not conducted in Phase I. Additionally, dissolved groundwater samples were not collected in Phase I.

4 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

5 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

Soil

Potential impacts from metals in surface soil were identified at DU18 based on the Phase I field investigation and the PSE. Potential impacts were not identified from other parameters in surface soil, and no potential impacts were identified from any parameters in subsurface soil. Based on these results, the Phase III field investigation included the collection of 16 surface soil samples for evaluation of metals.

All metals were detected in surface soil at DU18 during the Phase III field investigation in most of the sample locations, with the exception of antimony, cadmium, and silver which were detected in approximately half of the samples. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, none of the metals were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process.

Surface Water and Sediment

A revetted stream channel begins within wetlands in DU07 located to the northwest of DU18 and flows to the southeast adjacent to DU18. As part of the Phase III field investigation, a stream segment was established as SEA01 to assess potential impacts to surface water and sediment from DU07. Since SEA01 is upstream of DU18, the SEA01 data do not incorporate DU18 impacts but are generally expected to represent conditions adjacent to DU18 for the purposes of evaluating combined media exposures at DU18 (e.g., a trespasser at DU18 may encounter stream sediment and surface water). A total of 15 surface water and 15 sediment samples (locations CH-SWSD031 through CH-SWSD045) were collected from SEA01 for analysis of metals and SVOCs.

Section 4.2.1 provides a summary of COPC selection and potential impacts within SEA01, and **Appendix B2** provides tables of all analytical results. No COPCs were identified in sediment. PAHs were identified as COPCs in surface water; however, the results of the HHRA and ERA concluded that none of the COPCs posed potentially unacceptable risks, and thus, COCs were not retained in SEA01 surface water.

Groundwater

Assessment of groundwater was not warranted based on the CSM for DU18. Refer to Section 4.3 for a sitewide evaluation of groundwater.

Nature and Extent Summary and Potential Risks

The extent of investigation at DU18 is sufficient to complete the RI phase of the CERCLA process. The potential presence of metals in surface soil was the only remaining data element for the Phase III field investigation. As presented in Section 6.0, none of the metals were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. In addition, none of the COPCs retained for evaluation in the nearby SEA01 posed unacceptable risks to humans or ecological receptors. Accordingly, per the CERCLA process, further assessment or response action is not warranted for DU18.

4.2 Stream Exposure Areas

The Phase III investigation included surface water and sediment collection within eight SEAs located in the vicinity of DUs with potential migration pathways (e.g., overland flow, groundwater discharge) to the stream channels. The SEAs included samples that were upstream, adjacent, and/or downstream of DUs or groups of DUs. The goal of sampling within the SEAs was to create a robust dataset for surface water and sediment, and to establish representative EPCs from a realistic exposure area for potential human health and ecological receptors.

Surface sediment (0 to 0.5 ft bgs) and total surface water samples were collected and submitted for analysis of metals (including mercury in all samples and hexavalent chromium in 10% of samples) and SVOCs. Samples from SEA07 were also analyzed for PCBs to match with analyses at the upgradient DU (DU15). Field-filtered surface water samples were collected from a subset of locations and, as described in Section 2.5, laboratory-filtered surface water samples were analyzed for all locations outside of the hold time. Due to uncertainties associated with the filtered (dissolved phase) results, the total water samples represent the primary surface water dataset for the RI. The dissolved phase results are considered qualitatively, as needed, in the interpretation of the site condition and the characterization of potential risks.

4.2.1 SEA01: Near DU07

SEA01 is a revetted stream segment selected to assess potential impacts to surface water and sediment from DU07. SEA01 contains revetments and begins within DU07 and flows to the southeast towards Coast Artillery Road. DU18 is located along the same stream channel, but is downstream from SEA01. Therefore, impacts from DU18 are not reflected in samples collected from SEA01, but human and ecological receptors at DU18 may also be exposed to SEA01 (and the SEA01 data serves as a reasonable surrogate for locations adjacent to DU18). Refer to **Figure 2-4** for the location of SEA01 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-19a** for SEA-specific detail.

The Phase III RI field investigation at SEA01 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA01 includes 15 surface water and 15 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA01 encompasses approximately 584 ft of a revetted stream channel located within and downstream from DU07. The furthest upstream sample collected within SEA01 is located at the starting point of the stream in wetlands within DU07. The SEA flows to the southeast through a mixed hardwood forest with wetlands on either side of the stream channel. At the time of the stream characterization survey, the channel appeared to have perennial flow and was well-shaded. Groundwater seeps were observed in portions of the SEA.

Sediment deposition consisting of fine silt and organic material from the adjacent slopes was observed in portions of the stream. Surface water was flowing slightly, but no fish or invertebrates were observed. Deer tracks, turkeys, and a box turtle were observed within the SEA during the stream characterization survey. Skunk cabbage, ferns, jewelweed, and grassy plants (*Carex* spp.) were noted within and along the stream channel.

At the time of sample collection, the stream channel width ranged from an estimated 10 to 48 inches, and surface water depth ranged from an estimated 1 to 5 inches at the sampling locations. The turbidity of the stream ranged from 1 to 125 NTU, the pH ranged from 5.93 to 6.45, and the DO ranged from 2.57 to 6.40 mg/L. Additional water quality results are presented on **Table 3-4**.

An oily sheen was noted in deeper sediment (7 to 8 inches bgs) at location CH-SWSD038. The sheen was below the surface sediment sampling depth and was not sampled. No other sheens were noted within the SEA.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 15 surface water and 15 sediment samples (locations CH-SWSD031 through CH-SWSD045) were collected from SEA01 for analysis of metals and SVOCs. All 24 metals analyzed were detected in sediment at SEA01 and 20 metals were detected in surface water. In addition, 24 SVOCs were detected in sediment and 18 SVOCs were detected in surface water.

As presented in Section 6.0, iron, hexavalent chromium, benzo(a)pyrene, total BaP PAHs, and total HMW PAHs were retained as COPCs in surface water. Barium, beryllium, total chromium, hexavalent chromium, iron, manganese, nickel, and vanadium were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process.

The geochemical evaluation indicated that iron and hexavalent chromium in surface water, and barium, beryllium, total chromium, hexavalent chromium, iron, manganese, nickel, and vanadium in sediment, were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). All sediment COPCs were eliminated based on the geochemical evaluation. The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface water posed potentially unacceptable risks, and thus, none were retained as COCs. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COCs are associated with SEA01. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA01.

4.2.2 SEA02: Near DU11, DU12, and DU17

SEA02 is a revetted stream segment selected to assess potential impacts to surface water and sediment from DU11, DU12, and DU17. SEA02 begins just upstream from DU17 and flows southeast under Coast Artillery Road and past DU11 and DU12. SEA03 discharges into SEA02 just downstream from Coast Artillery Road near DU11 and DU12. Refer to **Figure 2-4** for the location of SEA02 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-20a** for SEA-specific detail.

The Phase III RI field investigation at SEA02 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA02 includes 20 surface water and 20 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA02 encompasses approximately 753 ft of a revetted stream channel located within and adjacent to DU11, DU12, and DU17. DU17 and DU12 are located along the SEA02 stream channel, and DU11 is located across an adjacent stream channel that discharges into SEA02. SEA02 flows to the southeast and passes underneath Coast Artillery Road. Land use surrounding the SEA north of the highway is forested and south of the highway is forested with a cleared parking area located on the eastern side of the SEA. At the time of the stream characterization survey, the channel appeared to have perennial flow and was well-shaded along the western side, but was more cleared and open along the eastern side. Groundwater seeps were observed in portions of the SEA both north and south of the highway. Reddish brown floc was observed in the SEA north of the highway.

Sediment deposition consisting of fine silt and organic material from the adjacent slopes was observed in portions of the stream, and erosion undermining the revetment stability was observed south of the highway. Surface water was flowing, but no fish or invertebrates were observed. Deer tracks, turkeys, and songbirds were observed within the SEA during the stream characterization survey. Skunk cabbage, ferns, jewelweed, elderberry (*Sambucus* spp.), and grassy plants (*Carex* spp.) were noted within and along the stream channel.

At the time of sample collection, the stream channel width ranged from an estimated 12 to 96 inches and surface water depth ranged from an estimated 2 to 8.5 inches at the sampling locations. The turbidity of the stream ranged from 14 to 9.9 NTU, the pH ranged from 5.63 to 7.48, and the DO ranged from 6.38 to 8.16 mg/L. Additional water quality results are presented on **Table 3-4**.

A sheen was noted on the water but not the sediment at locations CH-SWSD053, CH-SWSD055, CH-SWSD056, and CH-SWSD057. No odors were associated with the sheen, and algae and floc were noted at some locations. These conditions may be associated with the oxidation of iron by bacteria in the stream. Iron bacteria oxidize ferrous iron into insoluble ferric iron, which precipitates out of the water as a rust colored deposit. Iron concentrations in total water averaged just over 1,000 µg/L at these locations. Dissolved phase results are not available within this SEA, but it is likely that the iron is associated with particles and not in the dissolved phase. No other sheens were noted within the SEA.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 20 surface water and 20 sediment samples (locations CH-SWSD046 through CH-SWSD065) were collected from SEA02 for analysis of metals and SVOCs. All 24 metals analyzed were detected in sediment at SEA02 and 19 metals were detected in surface water. In addition, 22 SVOCs were detected in sediment and 15 SVOCs were detected in surface water.

As presented in Section 6.0, iron was retained as a COPC in surface water, and aluminum, arsenic, barium, beryllium, total chromium, hexavalent chromium, copper, iron, lead, manganese, nickel, vanadium, and 3,4-methylphenol were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that iron in surface water, and aluminum, arsenic, barium, beryllium, total chromium, hexavalent chromium, copper, iron, lead, manganese, nickel, and vanadium in sediment, were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface water or sediment posed potentially unacceptable risks, and thus, none were retained as COCs. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COCs are associated with SEA02. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA02.

4.2.3 SEA03: Near DU10 and DU11

SEA03 is a stream segment selected to assess potential impacts to surface water and sediment from DU10 and DU11. The SEA begins in DU10 and flows northeast through DU11, intersecting with another stream channel represented by SEA02. Portions of the SEA were dry during the sampling event. Five of the 14 sample locations within SEA03 were within a revetted portion of the channel located within DU11. The remaining locations were within a non-revetted portion of the stream within and downstream from DU10. For screening purposes in the risk assessments, SEA03 was classified as a non-revetted SEA because field notes indicated the majority of the locations did not have revetments visible at the time of sampling. A review of sampling photographs (**Appendix H**) and mapping of revetted stream segments (**Figure 4-21a**) indicated that two locations (CH-SWSD071 and CH-SWSD072) classified as non-revetted by the field team may have previously contained revetments. Refer to **Figure 2-3** for the location of SEA03 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-21a** for SEA-specific detail.

The Phase III RI field investigation at SEA03 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA03 includes 10 surface water and 14 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA03 encompasses approximately 473 ft of a revetted and non-revetted stream channel located within or downstream from DU10 and DU11. The stream channel begins within DU10 and flows northeast through DU11 where it intersects with a southeasterly flowing stream channel represented by SEA02. The five sample locations within the SEA03 stream channel in DU11 were revetted; several locations upstream of DU11were not revetted. Although two locations (CH-SWSD071 and CH-SWSD072) were initially classified as non-revetted, photographs showed that wood potentially from revetments was present alongside the SEA03 stream channel, indicating that portions of the revetments had been removed. The stream channel flows through woods with some some historically disturbed areas on the eastern side of the stream that are regenerating as early forest and meadows.

At the time of the stream characterization survey, several sampling locations were dry and other locations had standing water. It is possible that this stream channel dries out seasonally. Groundwater seeps were observed in portions of the SEA. Sediment erosion was noted under some revetments in portions of the SEA. Amphipods were observed in the water, but fish and signs of other wildlife were not noted. No sheens were noted during the sampling.

At the time of sample collection, the stream channel width ranged from an estimated 17 to 103 inches and surface water depth, where water was present, ranged from an estimated 0.75 to 2.5 inches. The turbidity of the stream ranged from 0.6 to 56 NTU, the pH ranged from 3.48 to 5.45, and the DO ranged from 3.16 to 8.63 mg/L. Additional water quality results are presented on **Table 3-4**.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 10 surface water and 14 sediment samples (locations CH-SWSD066 through CH-SWSD079) were collected from SEA03 for analysis of metals and SVOCs. All 24 metals analyzed were detected in sediment at SEA03 and 18 metals were detected in surface water. In addition, 23 SVOCs in were detected in sediment and nine SVOCs were detected in surface water.

As presented in Section 6.0, aluminum, hexavalent chromium, copper, and lead were retained as COPCs in surface water, and aluminum, antimony, barium, cadmium, hexavalent chromium, copper, lead, mercury, and zinc and PAHs were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that all four of the surface water COPCs, and aluminum, barium, hexavalent chromium, copper, lead, mercury, and zinc in sediment, were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA concluded that none of the remaining COPCs identified in sediment posed potentially unacceptable risks, and thus, none were identified as COCs for human health. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates, but not to birds and mammals; therefore, further evaluation of PAHs at SEA03 was conducted to determine whether the PAHs were indicative of a CERCLA release. This further evaluation included reviewing the spatial distribution of total PAHs (as discussed below), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs in SEA03 (**Appendix C5**). The further evaluation indicated that the PAHs in SEA03 could not be attributed to a CERCLA release.

The concentrations of total PAHs in sediment at SEA03 ranged from 0.13 mg/kg to 71 mg/kg. The highest concentrations of total PAHs were located in the downstream portion of SEA03 within the DU11 boundary (locations CH-SWSD066 through CH-SWSD071). The maximum detected concentration was at CH-SWSD066, the furthest downgradient sample location within SEA03. The distribution of total PAHs within SEA03 is shown on **Figure 4-21b**. In general, higher total PAH concentrations were measured in the revetted portions of SEA03 located within DU11, rather than in the non-revetted portions located further upstream within the SEA. Locations CH-SWSD071 and CH-SWSD072, which did not have revetments present in the stream channel during the Phase III RI field investigation but may have previously contained revetments, had moderate levels of total PAHs (18 and 2 mg/kg, respectively) between the ranges of total PAHs found in the revetted and non-revetted locations (**Figure 4-21b**). Summary statistics for PAHs are presented in **Table 4-2.** For informational purposes, both individual PAHs and PAH totals are shown. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA concluded that no COCs were associated with SEA03 in surface water or sediment. The results of the ERA indicated that no COCs were identified in surface water for aquatic receptors or sediment for birds and mammals. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates in some locations. However, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, further assessment or response action is not warranted for SEA03.

4.2.4 SEA04: Near DU13 and DU14

SEA04 is a stream segment selected to assess potential impacts to surface water and sediment from DU13 and DU14. SEA04 contains revetments and is part of the primary north-south channel at Camp Hero, transecting Coast Artillery Road via an underpass. The northern portion of SEA04 runs through the eastern side of DU14, and the southern portion of SEA04 falls approximately 75 ft west of DU13. Refer to **Figure 2-3** for the location of SEA04 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-22a** for SEA-specific detail.

The Phase III RI field investigation at SEA04 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA04 includes 16 surface water and 16 sediment samples for metals and SVOCs.

Description and Current Use

Currently, access to the majority of SEA04 is limited, with the exception of the southern portion where a wooden footbridge along the Battery 113 Trail crosses over the stream. No plans for development or future use of this area are proposed, aside from the continued use of the hiking trail.

Physical Characteristics and Surface Water Conditions

SEA04 encompasses approximately 582 ft of a revetted stream channel that flows to the south and passes underneath Coast Artillery Road. The SEA is within a mixed hardwood forest and no nearby wetlands were observed. At the time of the stream characterization survey, the channel appeared to have perennial flow and was well-shaded. Sediment deposition and erosion were observed in portions of the stream. Surface water was flowing, but no fish or invertebrates were observed. No sheens were noted during the sampling.

At the time of sample collection, the stream channel width ranged from an estimated 21 to 44 inches and surface water depth ranged from an estimated 1 to 8 inches. The turbidity of the stream ranged from 0.4 to 7.1 NTU, the pH ranged from 4.14 to 4.28, and the DO ranged from 6.98 to 7.81 mg/L. Additional water quality results are presented on **Table 3-4**.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 16 surface water and 16 sediment samples (locations CH-SWSD080 through CH-SWSD095) were collected from SEA04 for analysis of metals and SVOCs. A total of 23 out of 24 metals were detected in sediment at SEA04 and 18 metals were detected in surface water. In addition, 24 SVOCs were detected in sediment and 14 SVOCs were detected in surface water.

As presented in Section 6.0, none of the parameters detected in surface water or sediment at SEA04 were retained as COPCs based on the background evaluation and initial HHRA and ERA risk screening process. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COPCs are associated with SEA04. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA04.

4.2.5 SEA05: Near DU05 and DU06

SEA05 is a stream segment selected to assess potential impacts to surface water and sediment from DU05 and DU06. The SEA is Y-shaped and the southern branch is downgradient of DU05, while the northeastern branch is downgradient of DU06. The two stream channels merge together and flow to the north, eventually discharging into the primary east-west channel at Camp Hero.

Two of the 15 sample locations within SEA05 were within a non-revetted portion of the channel located within DU05. The remaining locations were in revetted areas within or downstream from DU05 and DU06. For screening purposes in the risk assessments, SEA05 was classified as a revetted SEA because the majority of the locations were revetted. Portions of the SEA were dry during the sampling event. Refer to **Figure 2-4** for the location of SEA05 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-23a** for SEA-specific detail.

The Phase III RI field investigation at SEA05 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA05 includes 13 surface water and 15 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA05 encompasses approximately 583 ft of a revetted and non-revetted stream channel located within and downstream from DU05 and DU06. Two locations in the upstream portion of the SEA within DU05 were not revetted, and the remaining 13 sampling locations were revetted. The SEA is Y-shaped with the southern branch beginning within DU05 and the northeastern branch beginning within DU06. The two branches merge together and flow to the northwest passing under Daniel Road and eventually discharging into the primary east-west channel.

Land use in the vicinity of DU05 and DU06 near SEA05 includes forests and wetlands, with a mowed lawn and picnic area located within DU06. The merged portion of the SEA flows to the northwest primarily through wetlands and forest. Reddish brown floc was observed in the SEA in the vicinity of DU06 and in the merged portion of the SEA.

Surface water was flowing very slowly at the time of sample collection and no fish were observed. Aquatic invertebrates were present and evidence of a box turtle, deer, songbirds, and turkey were observed. Skunk cabbage, jewelweed, and Jack-in-the-pulpit (*Arisaema triphyllum*) were present along and within the stream channel.

A sheen and orange floc were noted in the vicinity of location CH-SWSD103 within the DU05 boundary. No odor was associated with the sheen. Iron concentrations in total and dissolved phase water were over 1,300 µg/L in this location, and the sheen may be associated with the presence of iron bacteria.

Two locations in the upstream portion of the SEA within or near the DU06 boundary were dry at the time of sample collection. The stream channel width ranged from an estimated 32 to 122 inches and surface water depth where water was present ranged from an estimated 0.5 to 5.5 inches. The turbidity of the stream ranged from 2.2 to 66.1 NTU, the pH ranged from 5.84 to 6.52, and the DO ranged from 3.57 to 7.06 mg/L. Additional water quality results are presented on **Table 3-4**.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 13 surface water and 15 sediment samples (locations CH-SWSD096 through CH-SWSD110) were collected from SEA05 for analysis of metals and SVOCs. All 24 metals analyzed were detected in sediment at SEA05 and 21 metals were detected in surface water. In addition, 26 SVOCs were detected in sediment and 19 SVOCs were detected in surface water.

As presented in Section 6.0, cobalt, copper, and several individual and total PAHs were retained as COPCs in surface water, and aluminum, arsenic, barium, beryllium, total chromium, hexavalent chromium, copper, iron, lead, manganese, nickel, selenium, vanadium, bis(2-ethylhexyl)phthalate, 1-methylnaphthalene, and 2-methylnaphthalene were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that cobalt and copper in surface water and aluminum, arsenic, barium, beryllium, total chromium, hexavalent chromium, copper, iron, lead, manganese, nickel, vanadium, and zinc in sediment, were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA and ERA concluded that none of the remaining COPCs identified in surface water or sediment posed potentially unacceptable risks, and thus, none were retained as COCs. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COCs are associated with SEA05 in surface water or sediment. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA05.

4.2.6 SEA06: Near DU01, DU02, and DU03

SEA06 is a stream segment selected to assess potential impacts to surface water and sediment from DU01, DU02, and DU03. SEA06 is a Y-shaped SEA with branches beginning within DU03 on the western side and just downstream from DU02 on the eastern side. The two stream channels merge together within DU03 and flow to the south. Portions of the SEA were dry during the sampling event and revetments were not present within this SEA. Refer to **Figure 2-3** for the location of SEA06 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-24a** for SEA-specific detail.

The Phase III RI field investigation at SEA06 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA06 includes 14 surface water and 15 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA06 encompasses approximately 750 ft of a non-revetted stream channel located downstream from DU01, DU02, and DU03. The SEA is Y-shaped and the eastern branch may be impacted by DU01 and DU02, while the western branch may be impacted by DU03. Although DU01 is not located directly adjacent to the SEA, DU01 chemicals could potentially migrate to the stream channel through either groundwater discharge or overland runoff through wetlands adjacent to DU01. DU02 is located adjacent to the eastern end of SEA06 and the western portion of SEA06 begins in the center of DU03. Both DU02 and DU03 include wetlands that discharge into the SEA.

The SEA flows primarily to the south through palustrine forested wetlands. At the time of the stream characterization survey, the channel appeared to have perennial flow and was well-shaded. Groundwater seeps were observed in portions of the SEA.

Sediment deposition was observed in portions of the stream. Surface water was flowing, but no fish were observed. Aquatic invertebrates (caddisflies) and evidence of deer were observed within the SEA during the stream characterization survey. Skunk cabbage, grassy plants (*Carex* spp.), and *Phragmites* were noted within and along the stream channel.

At the time of sample collection, the stream channel width ranged from an estimated 12 to 78 inches and surface water depth ranged from an estimated 0.5 to 4 inches at the sampling locations with water flow. One sampling location (CH-SWSD111) was dry at the time of sampling. The turbidity of the stream ranged from 2.5 to 64.5 NTU, the pH ranged from 5.95 to 6.70, and the DO ranged from 3.36 to 8.45 mg/L. Additional water quality results are presented on **Table 3-4**.

A sheen was noted on the water but not in sediment at locations CH-SWSD116, CH-SWSD117, and CH-SWSD118. No odor was associated with the sheen. Water depth at these locations was very shallow (approximately 0.5 to 1 inch deep) and the water itself was orange in color. Floc was not observed, but the orange color may be associated with the oxidation of iron. A review of the iron concentrations in total surface water indicates that location CH-SWSD116 had the highest iron concentration in this SEA (141,000 µg/L compared to an SEA average of 15,800 µg/L). A dissolved phase sample also collected at CH-SWSD116 had 16,700 µg/L of iron, indicating that approximately 90% of the iron at this location appears to be associated with particles and not in the dissolved phase. Iron concentrations were lower at the other two locations, but dissolved iron was much lower than total iron at these locations as well. No other sheens were noted within the SEA.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 14 surface water and 15 sediment samples (locations CH-SWSD111 through CH-SWSD125) were collected from SEA06 for analysis of metals and SVOCs. All 24 metals analyzed were detected in sediment at SEA06 and 21 metals were detected in surface water. In addition, 20 SVOCs were detected in sediment and 11 SVOCs were detected in surface water.

As presented in Section 6.0, aluminum, total chromium, hexavalent chromium, cobalt, copper, iron, manganese, nickel, vanadium, and zinc were retained as COPCs in surface water, and hexavalent chromium and manganese were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that aluminum, hexavalent chromium, cobalt, copper, iron, manganese, nickel, and vanadium in surface water, and both COPCs in sediment, were consistent with natural conditions; thus, these metals were eliminated as COPCs. The results of the HHRA and ERA concluded that none of the remaining COPCs identified in sediment posed potentially unacceptable risks, and thus, none were retained as COCs. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COCs are associated with SEA06. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA06.

4.2.7 SEA07: Near DU15

SEA07 is a stream segment selected to assess potential impacts to surface water and sediment from DU15. SEA07 is part of the primary east-west channel at Camp Hero and flows to the west. The SEA contains revetments and begins just to the west of Camp Hero Road and flows past DU15. Refer to **Figure 2-3** for the location of SEA07 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-25a** for SEA-specific detail.

The Phase III RI field investigation at SEA07 was designed for the collection of unbiased surface water and sediment samples within the linear SEA. The dataset obtained for SEA07 includes 15 surface water and 15 sediment samples for metals, SVOCs, and PCBs.

Physical Characteristics and Surface Water Conditions

SEA07 encompasses approximately 363 ft of a revetted stream channel located downgradient from DU15. Although DU15 is not located directly along or within the SEA, DU15 chemicals could potentially migrate to the stream channel either through groundwater discharge or through overland runoff.

The SEA flows primarily to the northwest through mixed hardwood forests and wetlands, and the channel itself is well-shaded. At the time of the stream characterization survey, standing water was present but not flowing, and it is possible that this stream channel dries out seasonally. Several fallen trees were observed across the stream channel, primarily at the downstream end of the SEA.

Sediment deposition was observed in portions of the stream. No fish were observed, but turkeys were present and a dead salamander was noted at downstream location CH-SWSD139. Bushes were present along the stream channel, in some cases growing over and into the revetment structures. Skunk cabbage, grasses, and ferns were also observed along the channel. No sheens were noted during the sampling.

At the time of sample collection, the stream channel width ranged from an estimated 20 to 26 inches and surface water depth ranged from an estimated 1 to 10 inches. The turbidity of the stream ranged from 0.1 to 2.4 NTU, the pH ranged from 3.60 to 3.77, and the DO ranged from 1.74 to 6.86 mg/L. Additional water quality results are presented on **Table 3-4**.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 15 surface water and 15 sediment samples (locations CH-SWSD126 through CH-SWSD140) were collected from SEA07 for analysis of metals, SVOCs, and PCBs. Twenty three of 24 metals analyzed were detected in sediment at SEA07 and18 metals were detected in surface water. In addition, 21 SVOCs were detected in sediment and 12 SVOCs were detected in surface water. PCBs were detected in sediment but not surface water. Aroclors 1248, 1254, and 1260 were detected in sediment, and one or two Aroclors were detected in any single sample.

As presented in Section 6.0, total LMW PAHs were retained as a COPC in surface water, and various individual and total PAHs and PCBs were retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The results of the HHRA and ERA concluded that none of the COPCs identified in surface water or sediment posed potentially unacceptable risks. Refer to **Appendix B2** for tables of all analytical results.

Summary and Potential Risks

As presented in Section 6.0, the results of the HHRA and ERA concluded that no COCs were associated with SEA07 in surface water or sediment. Accordingly, per the CERCLA process, further assessment or response action is not warranted for SEA07.

4.2.8 SEA08: Near DU08

As described in the Phase III SAP (AECOM-Tidewater JV 2017b), SEA08 was selected to assess potential impacts on surface water and sediment within a stream that transects DU08 from a northeast-southwest direction. However, at the time of the sampling, DU08 was inundated with water and soil samples could not be collected as planned. Therefore, surface water and sediment samples were collected within the stream channel and inundated wetlands located elsewhere within the DU08 boundary.

For screening purposes in the risk assessments, SEA08 was classified as a non-revetted SEA because field notes indicated the majority of the locations did not have revetments visible at the time of sampling. However, the water depth at the time of sampling limited the visibility of the revetments in portions of the SEA. A review of sampling photographs (**Appendix H**) and mapping of revetted stream segments (**Figure 4-26a**) indicated that four additional SEA08 stations (CH-SWSD146 through CH-SWSD149) could be classified as revetted. Refer to **Figure 2-3** for the location of SEA08 within Camp Hero, **Figure 2-5** for the sitewide network of surface water and sediment samples, and **Figure 4-26a** for SEA-specific detail.

The Phase III RI field investigation at SEA08 was designed for the collection of unbiased surface water and sediment samples within the linear SEA, and was modified based on field conditions to include samples outside of the stream channel itself. The dataset obtained for SEA08 includes 15 surface water and 15 sediment samples for metals and SVOCs.

Physical Characteristics and Surface Water Conditions

SEA08 encompasses approximately 298 ft of a revetted stream channel and an area of inundated surface water within the DU08 boundary. SEA08 is located in the southeastern portion of Camp Hero State Park in the most downstream portion of the primary north-south channel just prior to the stream channel passing under Old Montauk Highway and into the ocean. This SEA flows to the southeast and is located downstream of DU07, DU10, DU11, DU12, DU13, DU14, and DU17.

Revetments were observed in the most upstream portion of the SEA where the channel is most clearly evident. The channel and revetments are less evident further into the SEA, and standing water was present across the wetlands within the DU. Erosion of the stream channel is occurring in areas where the revetments are failing. Land use in the vicinity of SEA08 is forest and wetlands. No sheens or floc were noted during the stream survey. Surface water within the stream channel was flowing slowly at the time of sample collection, but no fish or invertebrates were observed.

The stream channel width ranged from an estimated 45 to 102 inches (not including the inundated area) and surface water depth ranged from an estimated 2 to 12 inches, including the inundated area. The turbidity of the stream ranged from 0.1 to 88.8 NTU with low turbidity in the stream channel and higher turbidity in the ponded portion. The pH ranged from 5.18 to 6.46, and the DO ranged from 2.39 to 8.15 mg/L. Additional water quality results are presented on **Table 3-4**.

Nature and Extent of Contamination

As part of the Phase III RI field investigation, 15 surface water and 15 sediment samples (locations CH-SWSD141 through CH-SWSD155) were collected from SEA08 for analysis of metals and SVOCs. Twenty three of 24 metals analyzed were detected in sediment at SEA08 and 21 metals were detected in surface water. In addition, 25 SVOCs were detected in sediment and 16 SVOCs were detected in surface water.

As presented in Section 6.0, hexavalent chromium, cobalt, iron, lead, manganese, and nickel were retained as COPCs in surface water, and cadmium, hexavalent chromium, carbazole, dibenzofuran, and various individual and total PAHs retained as COPCs in sediment, based on the background evaluation and initial HHRA and ERA risk screening process. The geochemical evaluation indicated that all six COPCs in surface water and hexavalent chromium in sediment were consistent with natural conditions; thus, these metals were eliminated as COPCs (**Appendix L2**). The results of the HHRA concluded that none of the COPCs identified in sediment posed potentially unacceptable risks, and thus, no COCs were identified for human health. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates in some locations; therefore, further evaluation of PAHs at SEA08 was conducted to determine whether the PAHs were indicative of a CERCLA release. This further evaluation included reviewing the spatial distribution of total PAHs (as discussed below), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs (**Appendix C5**). The further evaluation indicated that the PAHs in SEA08 could not be attributed to a CERCLA release..

The concentrations of total PAHs in sediment at SEA08 ranged from 0.57 mg/kg to 61 mg/kg. Concentrations of PAHs in the revetted stream segments were higher than concentrations in the inundated pond area, with the maximum detected concentration at location CH-SWSD146 in the stream area. Although locations CH-SWSD146 through CH-SWSD149 were not initially classified as revetted during the Phase III RI field investigation (due to the elevated water levels), site mapping of revetted segments and the elevated PAH concentrations present in these samples are consistent with the presence of revetments (**Figure 4-26b**). The distribution for total PAHs at SEA08 is shown on **Figure 4-26b**. Summary statistics for PAHs are presented in **Table 4-2**. For informational purposes, both individual PAHs and PAH totals are shown. Refer to **Appendix B2** for tables of all analytical results.

<u>Summary and Potential Risks</u>

As presented in Section 6.0, the results of the HHRA concluded that no COCs are associated with SEA08 in surface water or sediment. The results of the ERA indicated that no COCs were retained in sediment or surface water for birds and mammals or in surface water for the aquatic community. The ERA indicated that PAHs in sediment could pose unacceptable risks to benthic invertebrates in some locations. However, further evaluation indicated that the PAHs could not be attributed to a CERCLA release (**Appendix C5**). Therefore, per the CERCLA process, further assessment or response action is not warranted for SEA08.

4.3 Sitewide Groundwater

A sitewide assessment of groundwater was conducted as part of the Camp Hero RI. During the Phase I RI field investigation, grab groundwater samples were collected from AOCs where groundwater was encountered. These grab groundwater samples were used to support the development of the AOC CSMs (and later, the DU-specific CSMs). However, because the grab groundwater samples were not collected from developed wells, were not sampled via low-flow sampling procedures, and exhibited extreme turbidity, they were not considered suitable for assessing true groundwater conditions.

The PSE of soil samples at Camp Hero, as well as field screening of the grab groundwater samples, indicated the potential for sitewide groundwater impacts including SVOCs, metals, and VOCs and PCBs in select areas based on the DU-specific CSMs. Therefore, a total of 43 permanent monitoring wells were installed at Camp Hero during the Phase II and III RI field investigations. Groundwater monitoring wells were installed in the perched groundwater lenses, with total depths ranging from 15 to 40 ft bgs. The monitoring well construction information for the sitewide network is presented on **Table 3-1**. Based on monitoring well development and low-flow groundwater sampling, the perched groundwater exhibits low yields, and monitoring wells were often very slow to recharge. The depth to groundwater in the monitoring wells ranged from 6 to 28 ft bgs across the site. Groundwater elevations and water quality data from both the Phase II and Phase III field investigations are presented on **Table 3-2**.

Of the monitoring wells installed, 15 were background monitoring wells (CH-MW001 through CH-MW015), which were constructed upgradient of potentially impacted areas and were presumed to be representative of background conditions. Data collected from the background wells were used to derive groundwater BTVs and complete the background evaluation. The remaining 28 monitoring wells were installed to assess potential sitewide impacts in groundwater at Camp Hero, in addition to potential localized impacts associated with the DUs. Wells were installed in the near vicinity of DUs that exhibited the potential for groundwater impacts.

The investigation of groundwater at the DU-specific level is described in the prior subsections of Section 4.1. An overview of sitewide hydrology and hydrogeology is provided in Section 3.0 and a summary of the groundwater potability assessment is provided in **Appendix K**. As indicated previously, the shallow perched groundwater at Camp Hero is unsuitable for drinking based on the perched groundwater characteristics and Suffolk County drinking water well standards. This section presents the nature and extent of contamination and associated potential risks for sitewide groundwater. Additionally, the STB area was not geographically connected to a DU, and therefore groundwater in the vicinity of the STB was evaluated as a distinct groundwater unit. The groundwater investigation at STB is also discussed in the subsections below.

4.3.1 Nature and Extent of Contamination

The Phase I RI field investigation was designed to determine the presence or absence of potential impacts from Camp Hero AOCs. Grab groundwater samples were collected from temporary wells installed during the DPT drilling activities at locations where groundwater was encountered in the borings. The sampling design consisted of biased locations to target potential source areas. A total of 66 grab groundwater samples were collected from 24 AOCs across the site during the Phase I field investigation. Parameter groups included VOCs, SVOCs, PCBs, and metals (except mercury). Refer to **Appendix B2** for the full analytical results and the Phase I Investigation Field Report (**Appendix E**) for the sampling locations associated with the Phase I RI field investigation.

As described in Section 4.1.1, approximately 5.30 ft of LNAPL was observed in piezometer PZ-3 at the former Building 203 AOC (now DU01) during the Phase I RI field investigation. As a result of the petroleum impacts, the former Building 203 AOC was prioritized in the Phase II RI field investigation. Six permanent monitoring wells (CH-MW016 through CH-MW021) were installed during Phase II at the former Building 203 AOC (now DU01) to assess local groundwater impacts related to the petroleum (**Figure 4-1c**). Groundwater samples were collected from five of the six permanent wells. A sample was not collected from CH-MW017, because approximately 1.98 ft of LNAPL (25.54 ft to 27.52 ft bgs) was observed at that location. Parameter groups included VOCs, SVOCs, and metals (dissolved and total, including mercury and hexavalent chromium). Because PCBs were not detected in any of the Phase I samples, additional sampling of PCBs was not performed. Refer to **Appendix B2** for the full analytical results and the Phase II Investigation Field Report (**Appendix F**) for additional details on the Phase II RI field investigation.

Based on the PSE for surface and subsurface soil collected across the site (**Appendix G**), as well as field screening of the grab groundwater samples, potential site impacts to groundwater were identified for SVOCs and metals sitewide, as well as VOCs and PCBs in the near vicinity of DUs that exhibited potential impacts associated with those chemicals. Additionally, VOCs in the vicinity of former AOCs AST-35, Fuel Pump House (FPH), STB, and the Motor Pool warranted additional evaluation due to field observations (including petroleum odor, staining of soil cores, and sheen on turbid groundwater from temporary wells) indicating potential petroleum impacts to groundwater.

The Phase III RI field investigation for groundwater was designed to assess groundwater on a sitewide basis, as well as a DU-specific basis, as warranted. The nature and extent of contamination at a DU-specific level is described in the prior subsections of Section 4.1. Groundwater in the vicinity of the former AOCs AST-35 and FPH were evaluated as part of the DU01 groundwater network, due to their geographic proximity to DU01. Groundwater in the vicinity of the Motor Pool was evaluated as part of the DU11 groundwater network. However, the STB AOC was not geographically connected to a DU, and therefore groundwater in the vicinity of the STB AOC was evaluated as a distinct groundwater unit.

The following subsections provide a summary of the results for the STB area and sitewide groundwater. Based on the potability assessment (**Appendix K**) and the conclusion that the shallow perched groundwater is not suitable for drinking, the HHRA exposure pathways for the STB area and sitewide groundwater consisted of potential dermal contact, incidental ingestion, and hypothetical vapor intrusion. The total recoverable groundwater results were used for evaluating the construction worker scenario because direct contact with shallow groundwater seeping into a trench is unlikely to be treated or filtered. No potential ERA risk pathways were identified for groundwater.

STB Area Groundwater

The STB area is located the western portion of Camp Hero along Daniel Road, immediately east of Building 22, a former Barracks Building (**Figure 2-4**). The suspected former tank was identified during the records review, and no closure documentation was available.

The Phase I RI field investigation was designed to determine the presence or absence of the suspected tank and to assess potential impacts associated with the tank. A geophysical survey was conducted around Building 22, which indicated a subsurface anomaly around the size of a tank on the east side. Small “test holes” were conducted at the STB location using shovels. Miscellaneous building debris was uncovered, but there was no evidence of a tank. However, a petroleum odor was noted in the uncovered soil; therefore, samples were collected. The sampling design consisted of biased sampling to target potential source areas. Parameter groups included VOCs and SVOCs in surface soil, subsurface soil, and grab groundwater. Refer to **Appendix B2** for the full analytical results and **Appendix E** for the sampling locations associated with the Phase I RI field investigation.

Potential site impacts were not identified in surface or subsurface soil based on the PSE (**Appendix G**). However, based on field observations (including petroleum odor, elevated PID readings, and sheen on turbid groundwater from temporary wells) and the detection of VOCs in grab groundwater samples, groundwater in the vicinity of STB warranted further evaluation for potential petroleum impacts. Therefore, three monitoring wells (CH-MW026 through CH-MW028) were installed during the Phase III RI field investigation to assess local groundwater conditions. Samples were collected for VOCs, SVOCs (total and dissolved), and metals (total and dissolved). **Exhibit 4-19** provides the progression of the field sampling implemented at STB. Refer to **Appendix B2** for the full analytical results.

Exhibit 4-19. STB Sample Quantities and Analyses by Phase

Phase	Surface Soil	Subsurface Soil	Groundwater	Surface Water	Sediment
I	*Quantity:* 4 *Analyses:* STARS list for fuel oil VOCs and SVOCs[1]	*Quantity:* 3 *Analyses:* STARS list for fuel oil VOCs and SVOCs[1]	*Quantity*: 2 grab *Analyses*: VOCs[2], SVOCs[3]	--	--
II	--	--	--	--	--
III	--	--	*Quantity:* 3 total & dissolved[4] *Analyses:* VOCs[5], SVOCs[6], metals[7]; MNA[8] in 10%	--	--

Notes

1 For Phase I AOCs with suspected petroleum impacts only, only selected VOCs and SVOCs from the NYSDEC STARS list for fuel oil and/or gasoline were analyzed in soil.

2 Phase I VOCs included the full TCL for VOCs in groundwater.

3 Phase I SVOCs included the full TCL SVOCs. Select SVOCs were analyzed by Method 8270D SIM to achieve lower LODs.

4 Phase III dissolved groundwater samples were collected for SVOCs and metals (including mercury and hexavalent chromium in 10% of samples).

5 Phase III VOCs included selected TCL VOCs based on PSE results, plus the NYSDEC STARS list.

6 Phase III SVOCs included selected TCL SVOCs based on PSE results, plus NYSDEC STARS list. Select SVOCs were analyzed by the Method 8270D SIM to achieve lower LOD.

7 Phase III metals included the full list of TAL metals including mercury plus hexavalent chromium analyzed in 10% of metals samples. ORP and pH analysis were conducted by the laboratory for soil and sediment samples.

8 MNA parameters were analyzed in 10% of groundwater samples. MNA parameters consisted of biochemical oxygen demand, total oxygen demand, total organic carbon, ferrous iron (field analysis), chlorides, sulfates and sulfides, nitrates and nitrites, alkalinity, methane, ethane, and ethene.

A total of 17 metals were detected in total groundwater and 12 metals were detected in the dissolved groundwater fraction. Six individual PAHs were detected in total groundwater and one other SVOC (di-n-butyl phthalate) was detected in the dissolved fraction. Only one VOC, trichloroethene, was detected in total groundwater, and it was only detected at one location (CH-MW028).

As presented in Section 6.0, trichloroethene, manganese, and total PAHs were retained as COPCs in total (unfiltered) groundwater, based on the background evaluation and initial HHRA risk screening process. However, the results of the HHRA concluded that none of the COPCs identified in groundwater near STB posed potentially unacceptable risks, and none were identified as COCs.

The potential presence VOCs, SVOCs, and metals in groundwater were the only remaining data elements for the Phase III field investigation. No COCs were retained in groundwater for STB. Therefore, the extent of investigation at STB is sufficient to complete the RI phase of the CERCLA process, and further assessment or response action is not warranted.

Sitewide Groundwater

As described above, a sitewide network of 43 groundwater monitoring wells was installed at Camp Hero during the Phase II and III RI field investigations. Of these wells, 28 wells (CH-MW016 through CH-MW043) were installed to assess potential sitewide impacts in groundwater at Camp Hero, in addition to potential localized impacts in the near vicinity of the various DUs and STB area, which are discussed in the sections above. Two rounds of samples were collected from five of the locations (CH-MW016 and CH-MW018 through CH-MW021). A sample could not be collected from location CH-MW017 during either phase due to the presence of LNAPL. One round of samples was collected from the remaining locations, for a total of 32 sitewide groundwater samples for metals and SVOCs (total and dissolved). VOC and PCB analyses were conducted in only a subset of these samples, as described below.

A total of 24 metals were detected in total groundwater and 23 metals were detected in the dissolved groundwater fraction. Nearly all metals were detected in sitewide groundwater in most of the samples, with the exception of the infrequent detections of antimony, cadmium, mercury, selenium, and thallium in the total and dissolved fractions and beryllium in the dissolved fraction only, which were detected in less than a quarter of the samples. Silver was not detected in any samples.

A total of 19 individual PAHs and six additional SVOCs were detected sitewide in the total groundwater fraction, with a low frequency of detection (eight of the individual PAHs were detected in more than a quarter of the samples). A total of 10 individual PAHs and seven additional SVOCs were detected sitewide in the dissolved groundwater fraction, also with a low frequency of detection (three PAHs, acenaphthene, naphthalene, and pyrene, were detected in more than a quarter of the samples sitewide). The majority of the maximum detections occurred in the vicinity of DU01, the location of the residual LNAPL plume.

VOCs were collected from 15 locations sitewide (CH-MW016, CH-MW018 through CH-MW028, CH-MW030, CH-MW032, and CH-MW043). These locations were identified in the PSE to have potential petroleum or VOC-related impacts in the vicinity. Two rounds of samples were collected from five of the 15 locations (CH-MW016 and CH-MW018 through CH-MW021), for a total of 20 sitewide groundwater samples for VOCs. A total of 23 VOCs were detected in total groundwater, with a low frequency of detection (each compound was detected in less than a quarter of the samples). Similar to the SVOC detections, the maximum detection of each VOC typically occurred in the vicinity of DU01, with the exception of tetrachloroethene, which had a maximum detection at CH-MW043 near the Motor Pool building.

PCBs were collected at two locations sitewide (CH-MW039 and CH-MW040). These locations were in the vicinity of DU15, which warranted further evaluation for PCBs based on the PSE. No PCB congeners were detected in either sample. Refer to **Appendix B2** for tables of all analytical results.

As presented in Section 6.0, the following compounds were retained as COPCs in total groundwater for the direct contact/incidental ingestion pathway, based on the background evaluation and initial HHRA risk screening process: arsenic, beryllium, manganese, five individual PAHs, total BaP PAHs, 1,1'-biphenyl, dibenzofuran, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, 2-butanone, acetone, benzene, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, m,p-xylene, n-propylbenzene, tetrachloroethene, trichloroethene, and xylenes. The following compounds were retained as COPCs in total groundwater for the vapor intrusion pathway: 1,1'-biphenyl, naphthalene, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, ethylbenzene, and trichloroethene.

The results of the HHRA concluded that none of the COPCs identified in sitewide groundwater posed potentially unacceptable risks, and thus, none were identified as COCs. Accordingly, per the CERCLA process, further assessment or response action is not warranted for sitewide groundwater, other than the further consideration of LNAPL at DU01 (additional details in Section 4.1.1.3).

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5.0 CHEMICAL FATE AND TRANSPORT

This section presents a discussion of properties that contribute to the fate and transport of selected chemicals in environmental media. Rather than presenting an extensive discussion for all parameters analyzed during the Camp Hero RI, this section focuses on only those parameters that significantly contributed to potential site-specific risks. As summarized in Sections 4.1 and 4.2 and discussed in detail in Section 6.0, the risk assessments indicated that individual PAHs and PAH totals could potentially pose risks in surface soil at DU12 and in sediment at SEA03 and SEA08; therefore, this section is focused on the fate and transport of PAHs. The behavior of chemicals differs in the various environmental media due to a variety of factors, such as their physical and chemical properties and the properties of the environmental medium into which the chemicals are released. The subsections below discuss these properties for PAHs, particularly as they relate to fate and transport in soil and sediment.

As summarized below, the most likely sources for PAHs in surface soil at DU12 included non-point sources such as vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance. At SEA03 and SEA08, PAHs in the revetted portions of these SEAs were likely associated with the presence of the revetments. In addition, PAHs present in DU12, SEA03, SEA08, and background locations were likely to be influenced by urban background contributions rather than point sources. Therefore, PAHs in surface soil at DU12 and in sediment at SEA03 and SEA08 could not be attributed to a CERCLA release.

5.1 Chemical Properties of PAHs

PAHs are a group of chemicals found throughout the environment primarily as a result of the incomplete combustion of organic substances. While some individual PAHs are manufactured, commercial production is not a significant source of these chemicals in the environment. Anthropogenic sources include residential burning of wood; industrial power generation; coal tar, coke, and asphalt production; petroleum catalytic cracking; vehicle exhaust from gasoline and diesel-powered engines; and weathering and residuals of asphalt roads. Natural sources include volcanoes, forest fires, crude oil, and shale oil; however, anthropogenic sources predominate (Agency for Toxic Substances and Disease Registry [ATSDR] 1995).

5.2 Fate and Transport Properties of PAHs

The movement of PAHs in the environment depends on properties like their water solubility, vapor pressure, and molecular weight. In general, PAHs do not easily dissolve in water. They are present in air as vapors, or adhere to surfaces of small solid particles. Some PAHs can evaporate into the atmosphere from surface water, but most sorb to solid particles and settle to the bottoms of rivers or lakes. In soils, the compounds are most likely to adhere tightly to particles. PAHs can break down to less short-lived products by reacting to sunlight and with other chemicals in the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks to months.

PAHs released to the air are subject to short- and long-range transport and removal from the atmosphere by deposition onto soil and water surfaces (ATSDR 1995). The PAHs deposited onto soil in the DUs would have tended to bind to organic carbon in the soil due to the relatively moderate to high soil organic carbon-water partitioning coefficients of individual PAHs (1.5E+03 liters per kilogram [L/kg] to 6.5E+06 L/kg) (USEPA 2018). PAHs with high vapor pressures that were deposited onto soil would have tended to volatilize (ATSDR 1995). Vapor pressures of individual PAHs range from a relatively low value of 7.00E-11 millimeters of mercury (mm Hg) to a relatively high value of 8.50E-02 mm Hg (USEPA 2018).

The PAHs deposited onto surface water in the SEAs would have tended to bind to organic carbon particles suspended in the water column and settle into the sediment, or volatilize due to the relatively high Henry's Law constant of some individual PAHs (ATSDR 1995). The Henry's Law constant for individual PAHs ranges from 1.4E-08 atmosphere (atm)-cubic meter (m^3)/mole to 5.2E-04 atm-m^3/mole. Henry's Law constants in the range of 10^{-3} atm-m^3/mole to 10^{-5} atm-m^3/mole are associated with significant volatilization, while constants less than 10^{-5} atm-m^3/mole are associated with limited volatilization (ATSDR 1995).

Other properties of PAHs that impact their fate and transport in the environment are relatively low water solubility and potential for degradation by microorganisms in soil and sediment (ATSDR 1995). Water solubility for individual PAHs ranges from 8.0E-5 mg/L to 3.1E+1 mg/L and indicates relatively low potential for dissolution into groundwater or surface water (USEPA 2018). PAHs can also bioaccumulate in plants, aquatic organisms, and animals (ATSDR 1995).

5.3 Distribution of PAHs

As indicated above, PAHs could potentially pose risks to humans or ecological receptors in surface soil at DU12 and in sediment at SEA03 and SEA08; therefore, this subsection is focused on the distribution of PAHs in these areas. All PAHs analyzed were detected in surface soil at DU12. The majority of those PAHs were also detected in sediment at SEA03 and SEA08. Benzo(a)pyrene, total HMW PAHs, total LMW PAHs, and total BaP PAHs were detected in surface soil at DU12 at concentrations that could pose potential risks to human and/or ecological receptors (additional details in Section 6.0). Total PAHs were detected in sediment at SEA03 and SEA08 at concentrations that could pose potential risks to ecological receptors (i.e., benthic community receptors).

DU12 and the two SEAs are located near or downgradient from several paved and gravel/sand roadways. Specifically, DU12 is transected by Coast Artillery Road, SEA03 is located approximately 100 to 250 ft south of Coast Artillery Road, and SEA08 is adjacent to Old Montauk Highway. Although Old Montauk Highway is a sand road, it receives regular traffic from recreational users that park their vehicles in the vicinity to fish along the shore. Additionally, SEA08 is located at the terminus of the Camp Hero surface water drainage system and receives storm water discharge from the entire eastern half of Camp Hero. PAHs likely migrate into streams throughout Camp Hero and are then transported through the drainage system to SEA08, prior to discharge to the Atlantic Ocean. A discussion of the distribution of PAHs at DU12, SEA03, and SEA08 relative to physical and chemical properties follows.

At DU12, total PAHs were detected in surface soil at concentrations that ranged from 0.51 mg/kg to 2,300 mg/kg in surface soil (**Table 4-2**), with concentrations generally increasing with proximity to Coast Artillery Road. The maximum detected concentration of PAHs was generally at DU12-S001, which was located along the north side of Coast Artillery Road near the entrance to the park maintenance and brush storage area, where vehicles enter and exit the area. **Figure 4-12b** presents the distribution of the PAHs in surface soil identified as posing potential risks in either the human health (benzo(a)pyrene and total BaP PAHs) or ecological (total HMW PAHs and total LMW PAHs) risk assessments. While some sample locations contribute more to the calculated site risks, the risk assessments were based on the evaluation of EPCs across each DU and SEA per the CERCLA process, to account for exposure across the area (Section 6.0). The surface soil encountered within the DU during installation of monitoring well CH-MW030 consisted of organic soil. PAHs are likely sorbed to organic carbon in the soil. Total PAHs were detected at a relatively low concentration of 6.2 µg/L in the one well (CH-MW030) located within DU12.

The presence of PAHs in surface soil at DU12, but not in groundwater, is consistent with the chemical's relatively high adsorption potential and relatively low solubility potential. Consistent with this principle, PAHs in subsurface soil at DU12 were detected at lower concentrations than in surface soil. As discussed above, DU12 is located adjacent to Coast Artillery Road and is likely to receive PAHs associated with the weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), ongoing road maintenance, and vehicle emissions (refer to Section 5.4 below for additional discussion of PAH source characterization). Because these PAHs are most likely strongly sorbed to the surface soil particles, they are unlikely to migrate into the subsurface soil or groundwater. The potential for wind and storm water erosion is present via travel in soil particulates, but the migration of these PAHs via volatilization or leaching is unlikely to be a major transport mechanism.

At SEA03, total PAHs were detected in sediment at concentrations that ranged from 0.1 mg/kg to 1.6 mg/kg in the portion of SEA03 located within DU10, 0.14 mg/kg to 18 mg/kg in the portion of SEA03 located between DU10 and DU11, and 22 mg/kg to 71 mg/kg in the portion of SEA03 located within DU11 (**Table 4-2**; **Figure 4-21b**). The sediment in SEA03 contained between 6% and 35% total organic carbon (TOC). The detected PAHs are likely sorbed to the organic carbon in the sediment. Total PAHs were not detected in surface water in the SEA except at locations CH-SWSD067 and CH-SWSD069. The concentrations of total PAHs in total surface water (unfiltered) at CH-SWSD067 and CH-SWSD069 were 0.23 µg/L and 0.65 µg/L, respectively; however, these levels were acceptable from a risk standpoint. The detected PAHs are likely sorbed to particulate matter in the surface water. The higher concentrations detected near DU11 may be associated with surface water drainage from the DU or proximity to Coast Artillery Road.

Additionally, the wooden revetments used to channelize surface water flow within SEA03 are likely to contribute to the total PAH concentrations. No information was available on the methodology for installation of the revetments, but based on the approximate timeframe, it possible that the revetments were treated with creosote, which contained PAHs. Refer to Section 5.4 below for additional details on the PAH source characterization.

At SEA08, total PAHs were detected in sediment at concentrations that ranged from 0.57 mg/kg to 61 mg/kg (**Table 4-2**; **Figure 4-26b**) with TOC content between 1% and 11%. Similar to SEA03, the PAHs at SEA08 are likely sorbed to the organic carbon in the sediment. PAHs were detected in surface water from SEA08 at relatively low concentrations ranging from <0.78 µg/L to 0.9 µg/L; however, these levels were acceptable from a risk standpoint. Concentrations of total PAHs in the sediments in the stream portions of SEA08 (13 mg/kg to 61 mg/kg) were higher than concentrations in the inundated pond area (0.57 mg/kg to 4.1 mg/kg). This observation supports the potential scenario described above that PAHs could have migrated into streams throughout the eastern half of Camp Hero and were then transported through the drainage system to SEA08. Additionally, similar to SEA03, the wooden revetments in the streams likely contribute to the total PAH concentrations at SEA08. The stream within SEA08 is revetted, whereas no revetments were observed in the pond area, even though historic mapping indicated revetments may have been present within the pond area.

The presence of total PAHs in sediment at SEA03 and SEA08, but mostly non-detect concentrations in surface water, is consistent with the relatively moderate-to-high adsorption potential and relatively low solubility potential of the chemicals. Because these PAHs are most likely strongly sorbed to the sediment particles, the potential for movement of sediment-bound constituents during periods of high flow events is present and may have resulted in the transport of some PAHs into SEA08 from upstream DUs and SEAs. However, the magnitude of particle transport is limited due to the shallow and low-flow conditions of the streams under normal conditions. The migration of these PAHs via volatilization or leaching is unlikely to be a major transport mechanism.

5.4 Source Identification of PAHs

Appendix C5 provides an additional characterization of PAHs in surface soil at DU12 and in sediment at SEA03 and SEA08 that was conducted as part of the uncertainty evaluation process of the HHRA and ERA. This evaluation was based on multiple lines of evidence which help to identify potential sources of the PAHs that may be posing risks in these areas. These lines of evidence included reviewing the spatial distribution of PAHs and the site history, conducting background comparisons based on a refined classification of revetments for sediment locations, calculating relevant PAH ratios, using statistical methods that included scatterplots, box-and-whisker plots, and cross-plots to evaluate/compare the proportions of PAHs based on petrogenic and pyrogenic sources, and conducting a visual review of laboratory chromatograms.

Petrogenic PAHs are hydrocarbons formed by the geochemical alteration of organic matter at moderate temperature (50-150°C) and pressure over very long (i.e., geologic) timescales. These PAHs enter urban environments from anthropogenic sources such as petroleum (crude oil or fuels) spills/leaks, coal-fired power plants, and municipal sewage treatment plants. Pyrogenic PAHs form when fuels and other organic matter are incompletely or inefficiently combusted or pyrolyzed at moderate to high temperatures (>400°C) over very short time intervals (Battelle Memorial Institute et al. 2003).

The evaluation indicated that the elevated PAH concentrations at DU12 were likely attributed to non-point sources such as vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance. As shown in **Figure 4-12a**, a former Fueling Station (former Building 36) was previously located to the northwest of DU12. Although the fueling station was not specifically investigated in this RI (refer to Section 4.1.12.3 on DU12 for additional details), a potential fuel release from the station was considered as a possible source for the high concentrations of PAHs detected within DU12. However, the statistical and graphical review of PAH ratios and the laboratory chromatograms for samples at DU12 indicated that the PAHs in surface soil were attributed to pyrogenic sources, which indicated the source is likely not related to a fuel spill from former Building 36. In addition, both the DU12 and background surface soil datasets were dominated by pyrogenic PAHs and likely to be influenced by urban background contributions rather than site-related point sources (**Appendix C5**).

The evaluation also indicated that, at SEA03 and SEA08, the wooden revetments used to channelize surface water flow within SEA03 and SEA08 likely contribute to the total PAH concentrations. No information was available on the methodology for installation of the revetments, but based on the approximate timeframe, it possible that the revetments were treated with creosote, which contained PAHs. The statistical background evaluation (**Appendix L1**) indicated that total PAHs in background sediment were higher in revetted streams than in non-revetted streams. The concentrations of total PAHs in sediment in the revetted portions of SEA03 and SEA08 (and in the revetted background streams) were also consistently higher than concentrations in non-revetted stream segments.

The additional background comparison for sediment (**Appendix C5**) confirmed that the PAHs in the revetted portions of SEA03 and SEA08 were likely associated with the presence of the revetments. In addition, the statistical evaluation of PAH ratios for the SEA03 and SEA08 samples and the background samples showed that all datasets were dominated by pyrogenic PAHs and likely to be influenced by urban background contributions rather than point sources. Potential sources of PAHs within the range of the calculated ratios may include a mix of coal tar, creosote, diesel and gas exhaust/soot, highway dust, wood burning emissions, and urban runoff.

5.5 Summary of Fate and Transport

The fate and transport evaluation at Camp Hero focused on PAHs, which were the only parameters found to contribute to potential site-specific risks (additional details in Section 6.0). PAHs are a group of chemicals found throughout the environment primarily as a result of the incomplete combustion of organic substances. Because DU12 and SEA03 are in close proximity to Coast Artillery Road, the most likely sources of PAHs at those DUs and SEAs are vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance. This finding was supported by the additional characterization of PAHs presented in **Appendix C5,** which considered statistical comparisons, graphical evaluations, and a review of sample-specific chromatograms of PAH data. These evaluations indicated that PAHs in these areas, as well as in background areas, are dominated by pyrogenic PAHs and appear to be influenced by urban background contributions, rather than point sources.

Additionally, the wooden revetments used to channelize surface water flow within streams may contribute to the total PAH concentrations in SEA03 and SEA08. A review of the sediment data for these SEAs and the background areas indicates that concentrations of PAHs are typically higher in revetted stream segments than in non-revetted streams. The additional background evaluation provided in **Appendix C5** confirmed that the concentrations of total PAHs in the revetted portions of SEA03 and SEA08 were not higher than the revetted background dataset. Therefore, it is likely that the PAHs found in these SEAs are associated with the presence of the revetments.

SEA08 is located at the terminus of the Camp Hero surface water drainage system and receives storm water discharge from the entire eastern half of the site. PAHs from the previously-listed sources likely migrate into nearby streams and travel through the drainage system to SEA08, prior to discharge to the Atlantic Ocean.

PAHs deposited onto soil have a tendency to bind to organic carbon, while PAHs deposited onto surface water have a tendency to bind to organic carbon particles suspended in the water column and then settle into the sediment. The primary transport mechanisms for PAHs at Camp Hero are the storm water erosion of surface soil particulates and movement of sediment-bound chemicals during periods of increased flow related to high rain events. The distribution of chemicals generally reflects these processes at SEA08, with higher concentrations of PAHs detected in the drainage channel compared to the adjacent pond area.

The multiple lines of evidence evaluated in the additional characterization of PAHs (**Appendix C5**) indicated that PAHs in surface soil at DU12 and in sediment at SEA03 and SEA08 were dominated by pyrogenic PAHs and likely to be influenced by urban background contributions rather than point sources; therefore, these PAHs could not be attributed to a CERCLA release.

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6.0 RISK ASSESSMENT

As described in Section 1.2.4, 47 AOCs were investigated during the Phase I and II field efforts at Camp Hero. A PSE was completed using the Phase I and II RI dataset to determine which AOCs required further assessment during the Phase III investigation. AOCs warranting further assessment were grouped into 18 DUs and eight SEAs to be evaluated in the risk assessments following the Phase III RI field efforts conducted in May and June 2017. Groundwater was evaluated on a sitewide basis, as well as a DU-specific basis in the near vicinity of DUs warranting further assessment for groundwater based on the PSE.

Figure 6-1 documents the general flow of the data evaluations conducted as part of the risk assessments. The following subsections discuss the risk assessment dataset and the background and geochemical evaluations, and summarize the findings of the HHRA and the ERA. As indicated on **Figure 6-1**, both the HHRA and the ERA follow the same general process to identify final COPCs for quantitative evaluation in the risk assessments. The ERA (**Appendix N**) uses the term chemicals of potential ecological concern (COPECs) to distinguish the ecological COPCs from the human health COPCs. For consistency, the term COPC is used in this RI for chemicals retained for evaluation in both the HHRA and the ERA.

The preliminary risk screening step included comparisons of maximum detected concentrations of chemicals against applicable human health or ecological screening levels and BTVs. The ERA also included a screening level food web model using maximum detected concentrations. Chemicals that exceeded the BTVs and the applicable screening levels (or that identified a potential risk in the food web model) were subject to the background hypothesis testing to determine whether site concentrations were consistent with background concentrations. If metals were not consistent with background concentrations (i.e., were not eliminated via hypothesis testing), they were also evaluated by a geochemical regression analysis to assess whether the detected levels were consistent with levels that occur naturally. Chemicals that exceeded BTVs and the applicable human health or ecological screening levels (or that identified a potential risk in the food web model), and were not deemed to be consistent with background conditions or with naturally occurring metals, were identified as final COPCs for evaluation in the HHRA and/or the ERA.

COPCs were quantitatively evaluated in the risk assessments. Chemicals with the potential for unacceptable risks following the risk calculations were evaluated for associated uncertainties. The uncertainty evaluation included further characterization of PAHs that posed potential risks to human and ecological receptors. The additional characterization of PAHs included reviewing the spatial distribution of PAHs (Section 4.0), considering the fate and transport properties of PAHs (Section 5.0), and conducting additional forensic characterization of PAHs (**Appendix C5**).

6.1 Risk Assessment Dataset

Surface soil, subsurface soil, groundwater, sediment, and surface water samples were collected and analyzed for traces of chemicals that may be present as a result of historical site activities. The risk assessment evaluations focused on the 18 DUs and eight SEAs identified in the Phase III RI SAP (AECOM-Tidewater JV 2017).

With the exception of "R"-flagged (rejected data), flagged results such as "J" flags (i.e., estimated values) were carried forward into the HHRA and ERA in all exposure media. A "J"-flagged result indicates that the analyte was positively identified and the associated numerical value is an estimated quantity with an unknown bias. Results that are biased high are flagged "J+" and results that are biased low are flagged "J-". The "J"-flagged result was treated as a detected concentration even though the chemical's true concentration is unknown (USEPA 1989).

The HHRA also included a well-by-well evaluation for groundwater, as well as sitewide groundwater evaluation and a DU-by-DU groundwater evaluation for groups of wells in close proximity to DUs. The risk assessment datasets considered in the HHRA and the ERA are described below and data tables are presented in Attachment A of **Appendix M** and **Appendix N**, respectively.

6.1.1 Surface Soil

Biased surface soil samples were collected from potential source areas within the DUs as part of the Phase I field effort. Surface soil data were collected from an unbiased grid from DU01 during the Phase II investigation. Surface soil data were collected from an unbiased grid from the remaining DUs during the Phase III investigation. The biased, targeted source area data from Phase I were not considered representative of the entire exposure area; therefore, the unbiased Phase II and III surface soil data were used in the risk assessments to represent exposure across each DU.

Surface soil (0 to 1 ft bgs) was collected in June 2017 from locations of natural habitat or landscaped areas within each of the DUs identified in the Phase III RI SAP (AECOM-Tidewater JV 2017). As indicated in Section 2.5, DU08 was submerged with water during the Phase III sampling effort, and surface soil samples were not collected as planned from this DU. In addition to terrestrial habitat, many of the DUs contained wetlands which were also sampled from 0 to 1 ft bgs. The soil samples were analyzed for SVOCs, metals, and PCBs. The analyte list for each DU was identified based on the PSE included in the Phase III RI SAP (AECOM-Tidewater JV 2017).

Surface soil samples (0 to 1 ft bgs) from within DU01 were not collected during Phase III because unbiased samples for VOCs, SVOCs, and metals were previously collected during Phase II. The Phase II surface soil data from DU01 were not previously evaluated in the PSE included in the Phase III RI SAP (AECOM-Tidewater JV 2017).

6.1.2 Subsurface Soil

The subsurface soil medium was evaluated in the HHRA but not the ERA, as subsurface soils were not considered to be a complete pathway for ecological receptors. Subsurface samples were collected from nine DUs in June 2017. The DUs warranting subsurface sampling were selected based on the findings of the PSE provided in the Phase III RI SAP (AECOM-Tidewater JV 2017). Subsurface soil samples were collected either from 1 to 10 ft bgs within upland portions of the DUs, or from 1 to 2 ft bgs in wetland boundaries or buffer zones at the same locations as surface soil. The entire subsurface depth horizon was composited for laboratory analysis. Analytical parameters for subsurface soil varied by DU based on the data needs established in the PSE and Phase III RI SAP, but generally included metals and SVOCs (AECOM-Tidewater JV 2017).

6.1.3 Groundwater

The groundwater medium was evaluated in the HHRA but not the ERA, as groundwater was not deemed to be a complete pathway for ecological receptors. A sitewide network of 43 groundwater monitoring wells was installed at Camp Hero during the Phase II and III RI field investigations. Of these wells, 28 wells (CH-MW016 through CH-MW043) were installed to assess potential sitewide impacts as well as potential localized impacts near the various DUs and the STB area. The remaining 15 monitoring wells (CHMW001 through CH-MW015) were used for the background evaluation. Field-filtered (dissolved phase) and unfiltered (total phase) samples were collected from all monitoring wells for SVOCs and metals. VOCs (total phase only) and PCBs (both dissolved and total) were collected at select wells in the vicinity of DUs that warranted evaluation for those compounds based on the PSE. The HHRA evaluated the dissolved and total phase results separately. The dissolved phase results were used for evaluation of the hypothetical resident potable use of groundwater scenario (i.e., the filtered results best represent the quality of water used for tap water). The total recoverable results were used for evaluating the construction worker scenario because direct contact with shallow groundwater seeping into a trench is unlikely to be treated or filtered.

Also, the HHRA evaluated potential vapor intrusion although no buildings are currently present at the DUs. Vapor intrusion occurs when volatile chemicals migrate from groundwater into an overlying building. The volatile chemicals can emit vapors that may migrate through subsurface into indoor air spaces to account for potential future exposure.

A potability analysis was conducted for Camp Hero (**Appendix K**), which concluded that the shallow perched groundwater at Camp Hero is not suitable as a potable water source (i.e., unsuitable for drinking based on the groundwater characteristics and New York State and Suffolk County drinking well standards). However unlikely, the drinking water exposure pathway was quantitatively evaluated for a hypothetical resident to assess the potential for unlimited use and unrestricted exposure (UU/UE) for future risk management decision-making, should the land use change.

6.1.4 Sediment and Surface Water

Co-located sediment (0 to 0.5 ft bgs) and surface water samples were collected in June 2017 from eight exposure areas within the tributaries draining the two watersheds of the Camp Hero. The SEAs were typically located adjacent to or downstream from one or more soil DUs. The sediment and surface water samples were analyzed for metals and SVOCs sitewide; additional parameters were added if evaluation was warranted based on the CSM of nearby DUs.

Field-filtered (dissolved phase) surface water samples were only collected from a subset of sampling locations, so the total recoverable phase surface water samples serve as the risk assessment dataset for quantitative evaluations. Dissolved phase results were considered qualitatively in the risk assessments to provide context for exceedances based on the total recoverable phase results, if needed.

As described above, many of the streams include wooden revetments, so SEAs were classified as either revetted or non-revetted based on whether revetments were observed by the field team at the majority of the sampling stations (the field team identified sampling locations with readily visible revetments in the stream channel). This classification determined whether an SEA was compared against the revetted or the non-revetted background sediment datasets during the COPC selection process. SEA03 and SEA08 were initially classified as non-revetted (field observations indicated 64% of the SEA03 stations and 67% of the SEA08 stations were not revetted; **Table 3-4**), but an additional review of maps and site photographs indicated that these SEAs likely contained additional revetted locations. Historic mapping indicated some of the locations classified as non-revetted by the field team may have contained revetments. Additionally, site photographs provided in **Appendix H** show evidence of deteriorated revetments at some locations not classified as revetted by the field team. In some cases, photographs showed that wood potentially from revetments was present alongside the SEA03 stream channel, indicating that portions of the revetments had been removed. In SEA08, the water depth at the time of sampling limited the visibility of the revetments in portions of the stream known to be revetted. Therefore, the classification of these as SEAs as non-revetted for background comparison purposes is a conservative approach and was re-visited as part of the further PAH characterization conducted in **Appendix C5**.

6.2 Background and Geochemical Evaluations

The Background and Geochemical Evaluations distinguish natural or background conditions from DoD-related chemicals, and are included as **Appendix L**. The findings from these evaluations were incorporated into the HHRA and the ERA to focus the risk assessments and RI on DoD-related chemicals.

6.2.1 Background Study

The Background Study documents the derivation of BTVs in soil, groundwater, surface water, and sediment and the population means comparison (hypothesis testing) completed in support of the risk assessments, and is included as **Appendix L1**. Sampling of background locations was conducted for soil in Phase I, groundwater in Phase II, and surface water and sediment in Phase III.

The primary objectives of the background study were to: (1) provide BTVs for screening chemical concentrations, and (2) perform statistical population means comparison between background and site data, where needed, for the HHRA and ERA. The background study was conducted in coordination with the USACE New England and New York Districts, as well as the USACE EMCX.

In general, the background samples were analyzed for the same list of metals and SVOCs analyzed in other RI sampling at Camp Hero (the primary exception was that background soil data were not analyzed for mercury). Specific data handling procedures are described in Section 2.2 and 2.3 of **Appendix L1**.

BTVs were used during the Camp Hero RI risk assessment process to distinguish chemical concentrations detected within DUs, SEAs, or groundwater from naturally occurring or anthropogenic background conditions. Section 3.0 of **Appendix L1** provides a detailed discussion of the BTV derivation for each dataset and Attachment C provides tables documenting the BTV selection process.

DUs, SEAs, or monitoring wells with chemical concentrations above risk-based screening criteria and BTVs were subject to hypothesis testing (i.e., site and background population means comparison) to further evaluate whether they were consistent with background. The comparison of two independent datasets was used for this evaluation. Typically, this method is used to compare the investigation area (i.e., DU or SEA) to the corresponding background area as part of the evaluation to determine if chemical concentrations are present at levels significantly greater than the background levels. This population-to-population comparison evaluates whether the mean site values were statistically greater than the mean background values. This statistical analysis was performed separately for each media and for each DU/SEA.

Section 4.3 of **Appendix L1** provides a summary of the population comparisons by media and detailed statistical results are summarized in Attachment E. The overall findings of the population comparisons are summarized as follows:

- Surface soil – 209 combinations of DU-chemicals were identified by the preliminary risk screening; 136 DU-chemicals were above background and 17 did not have corresponding background data (because mercury was not collected in background soil); therefore, these 153 DU-chemical combinations were retained for evaluation in the HHRA and/or ERA.

- Subsurface soil – 38 combinations of DU-chemicals were identified by the preliminary risk screening; 36 DU-chemicals were above background; therefore, these 36 DU-chemical combinations were retained for evaluation in the HHRA.

- Groundwater – 86 combinations of DU-fraction-chemicals were identified by the preliminary risk screening; 20 DU-fraction-chemicals were above background and 29 did not have sufficient site samples for evaluation; therefore, these 49 DU-chemical combinations were retained for evaluation in the HHRA.

- Sediment – 154 combinations of SEA-chemicals were identified by the preliminary risk screening; 95 DU-chemicals were above background and 1 did not have corresponding background data; therefore, these 96 SEA-chemical combinations were retained for evaluation in the HHRA and/or ERA.

- Surface water – 75 combinations of SEA-chemicals (total fraction only) were identified by the preliminary risk screening; 36 DU-chemicals were above background; therefore, these 36 SEA-chemical combinations were retained for evaluation in the HHRA and/or ERA.

6.2.2 Geochemical Evaluation

The Geochemical Evaluation distinguishes between naturally occurring levels of metal concentrations from levels that may be related to site contamination or anthropogenic contamination that may or may not be site-related. The Camp Hero Geochemical Evaluation is included as **Appendix L2**. The findings from the evaluation determine which metals, by media and by DU/SEA, should move forward through the HHRA and the ERA. The geochemical evaluation was conducted in coordination with the USACE New England District, New York District, and EMCX.

Metals that were retained as preliminary COPCs following the population comparison described in Section 6.2.1 were subject to the geochemical evaluation. Preliminary COPCs were either eliminated by the geochemistry evaluation (if deemed to be naturally occurring) or carried forward as a final COPC.

The results of the geochemical evaluation are presented in **Appendix L2** and the evaluation indicated that a number of metals could be eliminated as COPCs because they were deemed to be naturally occurring. However, certain metals were retained as COPCs because they did not show such relationships. The retained metals include:

- Surface soil –Cadmium, lead, and mercury were retained on a sitewide basis, and arsenic (DU06), barium (DU10), and thallium (DU06) were retained on a DU-specific basis as final COPCs for evaluation in the HHRA and/or ERA.
- Subsurface soil – Arsenic in DU06 was retained for evaluation in the HHRA.
- Surface water – Zinc was retained on a sitewide basis and total chromium was retained due to a low number of detected results (geochemical evaluation could not be conducted).
- Sediment –Cadmium and selenium were retained on a sitewide basis and antimony was retained due to a low number of detected results (geochemical evaluation could not be conducted).

Groundwater was only evaluated qualitatively for this analysis. Due to the variability of geochemical conditions in groundwater, as well as the influence of particulates, combining the data for correlation/regression analysis could lead to erroneous conclusions. Therefore, all of the total groundwater COPCs established after the background evaluation were retained to assess risk for the construction worker trench scenario in the HHRA.

6.3 Human Health Risk Assessment

The complete HHRA, with data tables and figures, is included as **Appendix M**.

6.3.1 Objectives

The primary objective of the HHRA is to evaluate whether final COPCs attributable to past Camp Hero activities have the potential to cause unacceptable adverse health effects to human receptors within the investigation area. The results of the HHRA are used to assess risk management options for each DU and SEA, including possible further actions to address impacted soils, groundwater, surface water, and sediment.

6.3.2 Identification of COPCs

Table 6-1 documents the HHRA COPCs that were carried forward for each DU and SEA. The COPCs were identified when the maximum detected concentration within a DU/SEA exceeded the Camp Hero-specific BTVs and human health screening criteria (Step 1; **Figure 6-1**). The most conservative of the New York State and USEPA human health screening criteria was selected as the human health screening criteria for the COPC selection process. **Table 6-2** summarizes the sources used for the selection of risk-based screening levels for the HHRA.

As shown on **Figure 6-1**, chemicals were also further evaluated using background hypothesis testing (Step 3) and a geochemical evaluation (Step 4). Step 2 on **Figure 6-1** is specific to the ERA, and thus Steps 1, 3, and 4 were implemented to identify the HHRA final COPCs. The COPC screening results eliminated all final COPCs at DU02, DU04, DU09, and DU17 from further evaluation in the HHRA. Final COPCs in DU05/SEA05 and DU18/SEA01 were also eliminated in the HHRA because the final surface water COPCs, benzo(a)pyrene and total BaP PAHs, could not be quantified for dermal exposure (wading in surface water) due to limitations with the USEPA steady-state water equations (USEPA 2004 and 2016). The remaining final COPCs within their respective DUs and SEAs were carried forward for HHRA risk calculations.

As part of the Step 1 COPC selection process, certain chemicals were selected for further evaluation in a data sensitivity analysis (DSA). The DSA addressed soil, surface water, sediment, and groundwater media. The maximum limit of detection (LOD) within each exposure media and DU was compared to the selected human health screening criteria to determine whether analytical detection limits were adequate for risk assessment purposes. If a chemical was all non-detect (ND) and has a maximum LOD lower than the screening level, then it was eliminated from further evaluation in the HHRA. If the maximum LOD was greater than the selected screening criteria, then it was identified as a LOD COPC; separate HHRA risk calculations were conducted and the results are discussed in **Section 6.3.6**, DSA Risk Evaluation.

6.3.3 Exposure Assessment

The HHRA evaluated the following current and future on-site exposure scenarios: a youth trespasser (current only; it was assumed that the park will open all areas following the investigation and remediation, if warranted), park employee, outdoor maintenance worker, and recreational user (child, adult, and lifetime).

Future on-site exposure scenarios that were addressed include a construction worker, indoor worker, and hypothetical resident (child, adult, and lifetime). The lifetime scenarios for the recreational user and the hypothetical resident represents the combined child and adult potential cancer risk estimates that is normalized over a lifetime of exposure (i.e., 70 years), assuming they continue to visit Camp Hero over the course of their lifetimes.

The current and expected future land use of the park is recreational. However, the inclusion of a hypothetical future resident in the HHRA was used to conservatively evaluate UU/UE for future risk management decision-making should the land use change. The hypothetical on-site resident scenario was treated as the worst-case exposure scenario and was exposed to all media and exposure pathways that were quantified for the other on-site receptors. The drinking water exposure pathway, however unlikely, was also quantitatively evaluated for the hypothetical on-site resident. A potability analysis was conducted for Camp Hero (**Appendix K**) and revealed that the shallow perched groundwater was not suitable as a potable water source. Potential excess lifetime cancer risk (ELCR) and non-cancer hazard results for the hypothetical on-site resident were provided in the HHRA for informational purposes only and were not used to identify COCs requiring remediation based on unacceptable risk. Instead, the other current and future exposure scenarios were used as the basis for risk management determinations for the RI report because they represent reasonable exposure scenarios (USEPA 1989).

The following exposure pathways were evaluated for each HHRA receptor:

- Soil-related exposure pathways include incidental ingestion, dermal contact, and inhalation of wind-blown particulates and/or vapors.
- Surface water-related exposure pathways include dermal contact while wading in the SEA; the surface water at Camp Hero is shallow and intermittent full immersion (swimming) is not likely. Incidental ingestion of surface water was considered an insignificant exposure pathway.
- Sediment-related exposure pathways include incidental ingestion and dermal contact while wading in the SEA.
- Groundwater-related exposure pathways include incidental ingestion, dermal contact, and inhalation of vapors (if volatile groundwater COPCs were identified) from shallow groundwater that has seeped into an excavation trench for an on-site construction worker. Although no buildings are present at the DUs, inhalation of groundwater vapors that have migrated into a hypothetical building (i.e., vapor intrusion) was evaluated for a future on-site indoor worker and hypothetical on-site resident. The potable use of groundwater exposure pathways (i.e., ingestion of tap water, dermal contact while bathing, and inhalation of vapors while showering/bathing) was evaluated under the hypothetical on-site resident scenario, however unlikely, for informational purposes.

For the future scenarios, the surface soil (0 to 1 ft bgs) and subsurface soil (greater than 1 ft to 10 ft bgs) COPC data were combined to create a total soil data set to evaluate possible future land redevelopment. Excavation activities may result in the subsurface soil being brought to the surface and mixed together. Soil data with depths ranging from 0 to 10 ft bgs (i.e., typical construction excavation depth) were used to derive total soil EPCs for the human health risk calculations. A ratio approach was used to weigh the soil concentrations before combining the surface and subsurface soil data sets (e.g., surface soil concentration was multiplied by a 1/10 ratio and subsurface soil concentration was multiplied by a 9/10 ratio). The ratio was adjusted according to the range of sample soil depths collected at the DU; site conditions (e.g., encountering shallow groundwater) determined the depth of each soil boring.

For some DUs, no subsurface soil data were collected because the PSE did not identify subsurface soil COPCs. The HHRA did not conduct a total soil evaluation for the following DUs: DU02, DU04, DU08, DU09, DU10, DU11, DU13, DU17, and DU18. The HHRA examined the areas where the NYSOPRHP plans to develop future camping grounds in close proximity to (but not directly within) DU04, DU06, DU16, and DU17, because these areas may be subject to construction activities that could mix the soil horizons. As noted above, DU04 and DU17 (as well as DU02 and DU09) were eliminated from further evaluation in the HHRA COPC selection process, so an evaluation of total soil was not warranted. HHRA risk calculations were conducted for DU06 and DU16 where a future on-site recreational user scenario was evaluated using total soil EPCs.

The potential for off-site exposure scenarios such as a current and future industrial worker and resident were considered in the HHRA. The perched groundwater conditions at Camp Hero prevent groundwater COPCs from flowing off-site in an underlying aquifer. Heavy vegetation and wetland conditions inhibit any wind-blown dust or vapors from migrating off-site. The streams are intermittent and do not feed into a surface water body or water bodies that supply drinking water for surrounding areas. Surface runoff to off-site areas was considered a minimal exposure pathway due to heavy vegetation. Therefore, off-site exposure was eliminated from further evaluation in the HHRA.

LNAPL in the subsurface at DU01 serves as a continuous source of petroleum-related chemical concentrations. The receptors most likely to have groundwater exposure at DU01 are the future on-site construction worker via an excavation trench scenario and a future on-site indoor worker via inhalation of indoor vapors in a hypothetical on-site building. The HHRA evaluated petroleum-related chemicals (e.g., benzene, toluene, ethylbenzene, xylenes, and PAHs) at DU01, and the HHRA risk results for the two worker scenarios were below the USEPA cancer and non-cancer target thresholds (Section 6.3.5).

6.3.4 Toxicity Assessment

The toxicity assessment is the relationship between the magnitude of exposure (dose or exposure concentration) and the incidence of adverse health effects associated with the human health COPCs. The HHRA selected toxicity values in accordance with the hierarchy of resources provided in the USEPA (2003a) guidance. Subchronic non-cancer toxicity values were used where available for the on-site construction worker due to the worker’s shorter term chemical exposure per USEPA guidance (USEPA 1989). Chronic non-cancer toxicity values were used for the remaining on-site receptors.

Some chemicals are identified as mutagens. A mutagen adversely affects the deoxyribonucleic acid (DNA) of a receptor; the mutated DNA causes malfunctioning or loss of function for a particular gene(s), and the accumulation of mutations may lead to cancer. USEPA has developed equations to address mutagenic health effects, especially for age-sensitive or developmental stages (e.g., on-site hypothetical child resident and youth trespasser) where mutagenic health effects are likely to occur (USEPA 2005). Mutagenic COPCs evaluated in the HHRA include hexavalent chromium, total BaP PAHs, and trichloroethylene.

6.3.5 Risk Characterization

The HHRA integrates the information developed in the exposure assessment and toxicity assessment into an evaluation of the potential human health risks associated with exposure to COPCs at each DU/SEA. Both potential cancer risks and non-cancer health effects were evaluated. The risk characterization also addresses the nature and extent of potential human health risks in comparison to state and federal target risk levels for making risk management decisions.

USEPA (1991) states that where the cumulative incremental current or future potential ELCR to an individual is less than 1E-04 (one in 10,000), action generally is not warranted unless there are adverse environmental impacts. The target risk range that USEPA uses to manage site risks as part of a Superfund Cleanup is 1E-06 (one in one million) to 1E-04 (one in 10,000). In effect, estimated risks that are less than 1E-06 are generally considered negligible, while risks greater than 1E-04 are usually considered sufficient justification for undertaking remedial action. Risks in the intermediate range between these two values can be considered acceptable on a case-by-case basis.

For non-cancer hazards, potential adverse health effects cannot be ruled out if the target hazard index (HI) is greater than 1. If the HI exceeds 1, chemicals are segregated based on the target organ endpoint, and separate target organ-specific hazard indices are calculated. Only chemicals that act on the same target organ are expected to be additive (USEPA 1989).

With the exception of DU11 and DU12, the estimated ELCR and non-cancer hazard results for the non-residential receptors evaluated at Camp Hero were below the USEPA target cumulative ELCR and non-cancer hazard thresholds (i.e., 1E-04 and 1, respectively). The following chemicals were identified as risk drivers for DU11 and DU12, causing the cumulative ELCR and HI estimates to exceed 1E-04 and/or the target organ-specific HI(s) to exceed 1:

- Benzo(a)pyrene is a noncarcinogenic risk driver in surface soil at DU11, and the potential pathway of concern is direct contact with surface soil (i.e., incidental ingestion, dermal contact, and inhalation of particulates) for the future on-site construction worker. Exposure to benzo(a)pyrene in surface soil may produce adverse developmental health effects (i.e., target organ-specific HI of 2 exceeded the USEPA threshold of 1). Subsurface soil samples were not collected at DU11 because the PSE did not identify any COPCs in the subsurface soil; therefore, surface soil is the exposure medium of concern at DU11.

- Benzo(a)pyrene is a noncarcinogenic risk driver in surface soil at DU12, and the potential pathways of concern are incidental ingestion and dermal contact with surface soil for the current on-site child recreational user. Exposure to benzo(a)pyrene in surface soil may produce adverse developmental health effects (i.e., target organ-specific HI of 2 exceeded the USEPA threshold of 1). The non-cancer hazard results for the total soil evaluation for the future on-site recreational user were below 1; therefore, surface soil is the exposure medium of concern at DU12.

- Total BaP PAHs is a carcinogenic risk driver in surface soil, and the potential pathways of concern are incidental ingestion and dermal contact with surface soil for the current on-site recreational user (lifetime) with a cumulative ELCR of 3E-04, exceeding the USEPA threshold of 1E-04). The cancer risk results for the total soil evaluation for the future on-site recreational user were below 1E-04; therefore, surface soil is the exposure medium of concern at DU12.

The current and expected future land use of the park is recreational. Residential reuse of the park is not expected to occur in the future. As noted above, a hypothetical on-site residential scenario was evaluated to assess the potential for UU/UE for future risk management decision-making should the land use change. The hypothetical resident risk results are summarized below for informational purposes only:

- The well-by-well groundwater evaluation evaluated each monitoring well at Camp Hero as a potential drinking water source. The evaluation identified monitoring wells near DU01, DU08, DU11, DU14, and STB as having potential ELCR and/or non-cancer hazards above the USEPA thresholds. Metals, PAHs, SVOCs, and VOCs were the risk drivers for the drinking water exposure pathway.

- The wells identified during the well-by-well evaluation as having cancer risk/non-cancer hazard estimates above USEPA thresholds were carried forward and separate HHRA risk calculations were conducted for the hypothetical resident. The potential ELCR and non-cancer hazard results for the hypothetical resident were above USEPA target risk thresholds at DU01, DU11, DU12, DU14, STB, and sitewide groundwater. Metals, PAHs, and VOCs were identified as the primary risk drivers in shallow groundwater due to the ingestion of groundwater as drinking water and vapor intrusion (inhalation of indoor vapors in a hypothetical residence) exposure pathways.

- Lead modeling results indicate that adverse health effects from exposure to lead in shallow groundwater at DU14 are possible for a hypothetical child resident, assuming the perched groundwater is used for drinking water.

- Total PAHs was identified as a primary risk driver for the hypothetical resident via incidental ingestion and dermal contact with sediment at DU10/SEA03 and DU15/SEA07. However, an additional statistical evaluation of sediment data was conducted to assess whether PAH concentrations in the revetted locations were consistent with the revetted background sediment dataset. The evaluation indicated that total PAHs from revetted/non-revetted locations are consistent with the revetted/non-revetted background datasets. The PAH concentrations in SEA03 sediment, for example, are consistent with background conditions and therefore the PAHs were attributed to non-CERCLA release.

6.3.6 Uncertainty Assessment

A weight-of-evidence evaluation was conducted where the results of the risk characterization and uncertainty assessment were combined, to further weigh the HHRA risk results for the DSA risk evaluation, DU01, DU11, DU12, and the hypothetical resident evaluation:

Data Sensitivity Analysis Risk Evaluation

- The LODs were compared to screening levels when either 1) the chemical was 100% ND in the DU/medium; 2) detected results were below their respective screening levels; or 3) detected results were above their screening levels but below their BTVs. The second and third conditions were added because the J-flagged results were treated as detected results in the HHRA (USEPA 1989). This leaves uncertainty for data not detected (i.e., the chemical concentration could potentially be higher than the J-flagged estimated value but less than the LOD). If the chemical was identified as a COPC, it is unknown if the estimated risk was under- or overestimated because its true concentration is unknown.

- The DSA ELCR estimates were in the 1E-06 range or lower. With the exception of the hypothetical on-site resident, the DSA HI estimates were roughly 1 to 2 orders of magnitude below 1.

The results of the DSA evaluation indicate that the conclusions of the HHRA are not likely to change if the DSA HHRA results were added to the existing HHRA risk calculations.

DU01

- The HHRA results for exposure to petroleum-related COPCs at DU01 were below the USEPA cancer and non-cancer target thresholds for the on-site non-residential exposure scenarios; the level of uncertainty associated with human health exposure to DU01 is reduced.

- The hypothetical resident risk results at DU01 exceeded the USEPA cancer and non-cancer target thresholds due to exposure to shallow groundwater via drinking water, showering/bathing, and inhalation of vapors in indoor air in a hypothetical residence. The hypothetical residential scenario and his/her exposure to shallow groundwater at DU01 are considered to be incomplete (see hypothetical resident evaluation below).

- The LNAPL identified at DU01 remains as a potential continuing source of petroleum-related chemical concentrations in shallow perched groundwater. However, the RI has delineated the extent of the LNAPL, and determined that NSZD processes appear to be actively depleting the LNAPL source and will continue to do so into the future. The level of uncertainty associated with human health exposure to LNAPL is reduced at DU01.

DU01 was eliminated from further evaluation because the non-residential exposure scenarios were below USEPA cancer and non-cancer target thresholds. Because there is an open NYSDEC Pollution Complaint Number (PC-1602757) for LNAPL at Building 203, DU01 will be addressed under the NYSDEC Spill Response Program in accordance with Article Twelve of the New York State Navigation Law.

DU11

- Benzo(a)pyrene in surface soil was identified as a risk driver for the future on-site construction worker at DU11. The on-site construction worker is not a likely scenario at DU11 because NYSOPRHP has no plans for developing areas at or near DU11 for future camping grounds or hiking trails; DU11 is a wooded area with dense vegetation that is generally inaccessible to the public.

- The surface soil exposure point concentrations (EPCs) for benzo(a)pyrene was influenced by elevated concentrations in a single surface soil sample DU11-S003. As an example, the benzo(a)pyrene concentration in the surface soil sample from DU11-S003 is 180 mg/kg and the remaining surface soil detections for benzo(a)pyrene ranged from 0.031 mg/kg to 1.7 mg/kg. The benzo(a)pyrene EPC (based on the upper confidence limit [UCL)] of the mean concentration) was 123.3 milligrams per kilogram [mg/kg]), which is well above the majority of the measured concentrations.

- The likelihood of an on-site construction worker spending 125 days out of the year for 8 hours each day at the DU11-S003 sample location would be quite low. Since NYSOPRHP has no plans for future development at DU11, the future on-site construction worker scenario is unlikely.

- The Phase I biased subsurface soil data was examined because the future on-site construction worker is more apt to be exposed to total soil (0 to 10 feet below ground surface) while excavating the area for future land redevelopment. The Phase I biased subsurface soil sample concentrations of benzo(a)pyrene ranged from 0.00071 mg/kg to 7 mg/kg. The PSE did not identify any subsurface soil COPCs for DU11 and therefore subsurface soil was not evaluated in the Phase III investigation.

- The maximum subsurface soil concentration of 7 mg/kg benzo(a)pyrene was used to estimate risk to the on-site construction worker in combination with groundwater and sediment media at DU11; the cumulative non-cancer hazard index (HI) was 0.3 which was below the USEPA threshold of 1.

- Also, chronic toxicity values for benzo(a)pyrene were used to estimate non-cancer health effects because subchronic toxicity values were not available.

- The HHRA uncertainty assessment concluded, based on the lines of evidence presented above, that the non-cancer cumulative HI of 3 for the future on-site construction worker at DU11 was likely overestimated. In addition, a review of the PAH ratios for the DU11-S003 sample indicated that the sample is pyrogenic and may represent creosote or coal tar which would not be associated with a CERCLA release.

Following the weight-of-evidence evaluation outlined above, benzo(a)pyrene was eliminated as a potential surface soil COC at DU11 in the HHRA.

<u>DU12</u>

- Benzo(a)pyrene and total BaP PAHs in surface soil were identified as the primary risk drivers for the current on-site recreational user scenario. The HHRA assumed that the recreational user would spend 100 days per year for 26 years at DU12 for recreational activities (e.g., camping, hiking, wading in streams, etc.). The results are likely biased high because NYSOPRHP has no plans for developing areas near or at DU12 for future camping grounds or hiking trails and no camping grounds are nearby DU12, so the recreational user is less likely to spend much time there.

- The Camp Hero background evaluation (Appendix L1 of the RI Report) identified concentrations of benzo(a)pyrene and total BaP PAHs in surface soil as being above background concentration.

- Three of the 16 surface soil benzo(a)pyrene concentrations at DU12 were above 100 mg/kg (ranging from 110 mg/kg to 150 mg/kg) at sample locations DU12-S001, DU12-S004, and

DU12-S008. The remaining surface soil sample results ranged from 0.043 mg/kg to 77 mg/kg.

- Coast Artillery Road runs through the middle of DU12. The southern portion of DU12 has a concrete foundation and the northern portion of DU12 contains a park maintenance area with piled brush (partially fenced but usually open).

- A former Fueling Station (former Building 36) was previously located to the northwest of DU12. The historical records associated with the former Fueling Station were reviewed during the records review phase of the RI. The USTs associated with the former Building 36 (USTs 24A, 24B, and 25) had an associated NYSDEC spill report, 93-09098, dated 25 October 1993. The spill report was closed later in 1993 with a NYSDEC-Region 1 Tank Removal Report. The USTs/the former fueling station was not investigated during the Phase I RI field program as an AOC because NFA was required by NYSDEC (there were no COCs above regulatory action levels). Although the fueling station was not specifically investigated in this RI, a potential fuel release from the station was considered as a possible source for the high concentrations of PAHs detected within DU12 near the former fueling station. However, the PAH source evaluation conducted as part of this additional characterization of PAHs (refer to Section 6.0) indicated the PAHs at DU12 were likely pyrogenic in source, which indicates the source is likely not related to a fuel spill from former Building 36.

- Given the lack of other potential point-sources within DU12 and the proximity of the roadway to the most elevated PAH concentrations, the most likely sources of PAHs in surface soil at DU12 are expected to be vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance. Also, the soil boring logs for DU12 (Appendix I of the RI Report) indicate evidence of demolished asphalt parking lot materials (black coloring, concrete fragments, tar, and pulverized brick)

Following the weight-of-evidence evaluation, total benzo(a)pyrene and BaP PAHs were eliminated from further evaluation in the HHRA. The additional characterization of PAHs evaluation (**Appendix C5**) indicated that the PAHs in surface soil may be attributed to non-CERCLA releases.

Hypothetical Resident Evaluation

- The current and expected future land use is non-residential (recreational) and therefore the hypothetical on-site resident is not a likely scenario for Camp Hero. A hypothetical residential scenario was evaluated to assess the potential for UU/UE for future risk management decision-making should the land use change.

- The Camp Hero potability analysis (**Appendix K**) revealed that the shallow perched groundwater at Camp Hero was not suitable as a potable water source. However, the drinking water exposure pathway was still quantitatively evaluated even though the drinking water exposure pathway is considered incomplete.
- The estimated cancer risks and non-cancer hazards for a hypothetical resident scenario were above USEPA target risk thresholds at DU01, DU11, DU14, STB, and sitewide groundwater. Exposure to shallow groundwater was the primary exposure medium of concern; metals, PAHs, and VOCs were identified as the primary risk drivers due to the ingestion of groundwater as drinking water as well as inhalation of vapors while showering/bathing and in indoor air (vapor intrusion).

Any chemicals that are driving the residential risk were not identified as COCs unless these chemicals were identified as contributing to an unacceptable risk to one or more of the other potentially complete Camp Hero on-site non-residential exposure scenarios (e.g., recreational user, park employee, outdoor maintenance worker, etc.).

6.3.7 Summary and Conclusions

The HHRA results indicated potential adverse health effects from exposure to surface soil could occur for the future construction worker from exposure to benzo(a)pyrene in surface soil at DU11 and for the current recreational user from exposure to benzo(a)pyrene and total BaP PAHs in surface soil at DU12. These risk drivers were eliminated from further evaluation in the HHRA after reviewing the spatial distribution of total PAHs (Section 4.0), considering the fate and transport properties of PAHs (Section 5.0), conducting additional forensic characterization of PAHs (**Appendix C5**), and conducting the uncertainty assessment (Section 6.3.6). The additional lines of evidence indicate that the future on-site construction worker risk results from exposure to benzo(a)pyrene in surface soil at DU11 were likely overestimated. Also, PAHs in surface soil at DU11 were influenced by elevated concentrations of PAHs in a single surface soil sample which may represent creosote or coal tar which would not be attributed to a CERCLA release. As for DU12, the current on-site recreational user risk results from exposure to benzo(a)pyrene and total BaP PAHs in surface soil at DU12 were likely overestimated. Also, the presence of benzo(a)pyrene and total BaP PAHs in surface soil at DU12 could not be attributed to a CERCLA release. In conclusion, the HHRA results did not identify any chemicals that required further evaluation in the RI.

6.4 Ecological Risk Assessment

The complete ERA, with data tables and figures, is included as **Appendix N**.

6.4.1 Objectives and Approach

The primary objective of the ERA is to evaluate whether COPCs attributable to past site activities have the potential to cause unacceptable adverse risk to ecological receptors within the area under investigation. The ERA focuses on surface soil, surface water, and sediment exposure pathways. Chemicals in surface soil may be contacted directly by plants and invertebrates living in the soil. Chemicals in sediment and surface water may be contacted directly by aquatic or benthic invertebrates living in the wetland. Wildlife foraging at Camp Hero could also be exposed directly to chemicals in soil, surface water, and sediment through incidental ingestion of soil, surface water, and sediment and/or indirectly by ingestion of contaminated prey items living at the site.

The approach for conducting the ERA was consistent with the eight-step tiered approach presented in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final* (USEPA 1997) and additional documents including *Guidelines for Ecological Risk Assessment* (USEPA 1998), and *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (USEPA 2001). This tiered approach incorporates different levels of assessment complexity as recommended in:

- Tri-Service Environmental Risk Assessment Working Group (TSERAWG), 2008. *A Guide to Screening Level Ecological Risk Assessment*, TSERAWG TG-090801. September;
- U.S. Army Biological Technical Assistance Group, 2005. *Technical Document for Ecological Risk Assessment, A Guide to Screening Level Ecological Risk Assessment*, U.S. Army Environmental Center. Aberdeen Proving Ground, MD, April; and
- USEPA (USEPA 1997) and New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) guidance for ERAs (NYSDEC and NYSDOH 2006).

The ERA consists of two primary components: Tier 1 screening-level ecological risk assessment (SLERA) consisting of USEPA's Steps 1 and 2, and Tier 2 baseline ecological risk assessment (BERA) consisting of the preliminary problem formulation for Step 3 (i.e., Step 3a). Both components are included in **Appendix N**.

The Tier 1 SLERA identifies COPCs that may pose adverse effects to ecological receptors, thereby focusing efforts on those chemicals most likely to be associated with excess risk of adverse effects to plants, soil invertebrates, wildlife, aquatic life, and benthic organisms. Maximum detected concentrations (MDCs) of chemicals detected in soil, surface water and sediment potentially impacted by the sites were compared to protective screening criteria and background data to identify COPCs for further evaluation in the Tier 2 BERA. Chemicals with MDCs that exceed screening values and background/natural conditions (including background concentration comparisons and a geochemical evaluation) for a specific medium, and those non-detected chemicals with LODs that exceed their screening value or background conditions, were retained as COPCs for that medium in the Tier 2 BERA where a more site-specific evaluation was conducted.

It is recognized that, for CERCLA sites, background conditions are typically used in the ERA to refine COPCs in Step 3a (USEPA 2001), rather than in the upfront selection of COPCs. However, the PDT agreed to include background data in the selection of COPCs for the Camp Hero ERA as part of the sequential evaluation of the DUs and exposure areas in order to focus on potentially site-related COPCs. This approach is consistent with NYSDEC guidance on the use of background in site characterization and remediation (NYSDEC and NYSDOH 2006; NYSDEC 2006). However, the approach agreed upon considers background conditions earlier in the ERA process than is recommended in DoD guidance (TSERAWG 2011).

6.4.2 Tier 1 Screening-Level Ecological Risk Assessment

The primary objective of a Tier 1 SLERA is to determine which, if any, exposure pathways and COPCs warrant further evaluation in a more refined ERA. The SLERA included comparisons of maximum detected concentrations of chemicals against conservative media-specific screening values and food web modeling using conservative assumptions to assess whether further evaluation was warranted for any exposure pathways and COPCs. Background conditions and geochemical conditions were also considered in the SLERA. The background evaluation used BTVs and statistical population comparisons between background and site datasets. The geochemical evaluation considered background and site data to distinguish between concentrations of inorganic chemicals that are characteristic of ambient conditions and levels that are likely to have resulted from historical site activities. Details of the background evaluation and the geochemical evaluation are presented in **Appendix L**.

The SLERA evaluated the following exposure areas, receptors, and media:

- Surface Soil (0–1 ft bgs): Evaluated for potential risks to terrestrial plants, soil invertebrates, birds, and mammals in the terrestrial/wetland DUs of Camp Hero.
- Freshwater Surface Sediment (0–0.5 ft bgs): Evaluated for potential risks to freshwater benthic invertebrates, birds, and mammals in the SEAs of Camp Hero.
- Freshwater Surface Water: Evaluated for potential risks to the aquatic community, birds, and mammals in the SEAs of Camp Hero.

The Tier 1 SLERA concluded that certain metals, SVOCs, VOCs, and total PCBs may pose a potential risk to plants, invertebrates, and/or wildlife. As described in Section 3.6 of **Appendix N**, based on the results of the Tier 1 SLERA, a Tier 2, Step 3a BERA was prepared to further assess the potential for adverse effects to ecological receptors at Camp Hero. **Table 6-1** summarizes the detected COPCs retained in each DU and SEA. The COPCs, as well as non-detect chemicals with LODs above screening values, were considered further in the Tier 2, Step 3a BERA.

No surface soil COPCs were retained in DU04 or DU18 and no surface water or sediment COPCs were retained in SEA04. In addition, no sediment COPCs were retained in SEA01 or SEA06 and no surface water COPCs were retained in SEA02, SEA03, or SEA08. These exposure areas were eliminated from further evaluation in Tier 2.

6.4.3 Tier 2 Baseline Ecological Risk Assessment, Step 3a

The purpose of Tier 2, Step 3a is to reevaluate COPCs that were retained in the SLERA and to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative exposure scenarios. Using less conservative but more realistic Tier 2, Step 3a assumptions, the Tier 1 SLERA risk estimates were recalculated for the pathways and COPCs retained at the end of the Tier 1 SLERA.

Refinements included in the Tier 2, Step 3a evaluation included the use of the 95% UCL on the arithmetic mean (instead of the maximum concentrations) and means as EPCs, the use of alternate media-specific screening values, the use of refined exposure parameters for birds and mammals, and consideration of site media concentrations in the context of natural geochemical conditions.

The results of the Tier 2, Step 3a evaluation are summarized in the following sections, and details are provided in the ERA included as **Appendix N.** Section 4.2 of **Appendix N** describes the refinements included in the Tier 2, Step 3a evaluation and Section 4.3 presents the refined risk calculations. Section 4.4 discusses uncertainties in the evaluation, Section 4.5 presents the risk characterization discussion, and Section 4.6 summarizes the results of the ERA.

6.4.3.1 Soil Invertebrates and Terrestrial Plants

DU02, DU04, DU09, DU13, DU17, and DU18 were eliminated from the ERA process for soil invertebrates and terrestrial plants based on the Tier 1 evaluation, and were not considered in Step 3a.

The potential for risks to soil invertebrates and terrestrial plants was evaluated by comparing soil EPCs against screening values and BTVs. Due to uncertainties associated with the conservative nature of the screening values, a review of the basis of the toxicity information behind the screening values was also conducted to assess whether the screening values were overly conservative.

For the three DUs with potential petroleum-related impacts (DU01, DU06, DU11), the potential for risks to plants and soil invertebrates due to PAHs in DU06 and DU11, and the potential for risks to plants due to arsenic and thallium in DU06, were not ruled out based on the comparison to screening values and BTVs. Although acetone in DU01 and a few individual non-PAH SVOCs (benzoic acid, 1,1'-biphenyl, carbazole, and dibenzofuran) in DU06 and DU11 were initially retained based on criteria exceedances, these criteria are likely overestimating risks to lower trophic level receptors, and these COPCs are unlikely to represent a significant risk. Therefore, based on the comparisons to screening values and BTVs, PAHs in surface soil may pose an unacceptable risk to plants and soil invertebrates in DU06 and DU11, and arsenic and thallium in surface soil may pose an unacceptable risk to plants in DU06. However, risks to plants and invertebrates may be overestimated due to uncertainties in the screening values and the likelihood that studies conducted in the laboratory with bioavailable chemicals are likely to overestimate risks under the field conditions. Following a review of the basis of the screening values and the magnitude and extent of the exceedances, risks to plants and soil invertebrates in these three DUs are expected to be overestimated and not sufficient to warrant carrying these COPCs further in the ERA process.

For the remaining DUs evaluated in Step 3a, significant site-related risks to soil invertebrates and plants are not expected in DU03, DU05, DU07, DU10, DU14, DU15, and DU16. Although benzoic acid, 1,1′-biphenyl, carbazole, dibenzofuran, and mercury were initially retained in some DUs based on criteria exceedances, these criteria are likely overestimating risks to lower trophic level receptors, and these COPCs are unlikely to represent a significant risk. In addition, lead in DU07 only exceeded the plant-based screening value in one of 16 locations, indicating a small spatial extent of the DU in excess of even the conservative screening value. Based on the uncertainties associated with the screening value, and the relatively low magnitude and infrequency of the exceedances for lead in DU07, this COPC was not retained for further evaluation in the ERA.

Although uncertainties are associated with the plant and soil invertebrate screening values, concentrations of PAHs were well above the associated soil screening values and BTVs in multiple sampling locations across DU12. Further characterization of PAHs in surface soil was conducted for DU12 to determine whether the PAHs were indicative of a CERCLA release. This evaluation (**Appendix C5**) indicated that the PAHs in DU12 were predominantly pyrogenic, rather than petrogenic, and likely influenced by urban background sources, rather than a point source release. Given that the PAHs in DU12 could not be attributed to a CERCLA release, no further evaluation of PAHs in DU12 surface soil is required under CERCLA.

6.4.3.2 Terrestrial Wildlife

DU03, DU04, DU13, and DU18 were eliminated from the food web evaluation based on the results of the Tier 1 food web model, and were not considered in Step 3a.

For the three DUs with potential petroleum-related impacts (DU01, DU06, and DU11), no unacceptable risks to wildlife are expected within DU01; however, the potential for risks to birds and mammals due to PAHs in DU06 and DU11 was not ruled out. In DU06, the N-HQs, but not the L-HQs, for total HMW PAHs are greater than 1 for the vole, robin, and shrew. However, given the conservative nature of the food web model, the lack of total LMW PAH HQs above 1, and the lack of L-HQs above 1 for HMW PAHs, soil exposure due to PAHs does not present an unacceptable risk of adverse effects to wildlife populations, although sensitive individuals may be affected. In DU11, N-HQs and L-HQs for total HMW PAHs and total LMW PAHs are greater than 1 for both birds and mammals. Therefore, PAHs in surface soil may pose an unacceptable risk to birds and mammals in DU11. A review of the PAH data in DU11 indicates that one location (DU11-S003) drives up the EPC, and thus the DU risks. The concentrations in the remaining 15 samples in DU11 are one to two orders of magnitude lower than in DU11-S003 and would not result in significant risks to birds and mammals. Given the small size of the DU, no more than one or a few individual ecological receptors would be expected to occupy the DU and a single elevated concentration would be unlikely to result in a population level impact. In addition, conservative factors within the food web model are likely to overestimate risks to foraging receptors. Therefore, adverse impacts to foraging birds and mammals in DU11 are likely to be overestimated by the EPC, and adverse effects on wildlife populations are unlikely. In addition, a review of PAH ratios for the DU11-S003 sample (**Appendix N)** indicated that the sample is pyrogenic and may represent creosote or coal tar which would not be associated with a CERCLA release.

For the remaining DUs, significant site-related risks to birds and mammals are not expected in DU02, DU05, DU09, DU10, DU14, DU15, DU16, and DU17. In DU07, the N-HQs, but not the L-HQs, for lead are greater than 1 for the robin and shrew. A review of the lead data indicates that the EPC is driven by one concentration from location DU07-SO04 that is an order of magnitude above the other lead concentrations. In addition, given the conservative nature of the food web model and the lack of N-HQs above 1, soil exposure due to lead does not present an unacceptable risk of adverse effects to wildlife populations, although sensitive individuals may be affected. In DU12, N-HQs and L-HQs for total HMW PAHs and total LMW PAHs are greater than 1 for both birds and mammals. However, as indicated above, additional characterization of the PAHs in the DU12 surface soil samples indicates that the PAHs could not be attributed to a CERCLA release and no further evaluation is warranted.

A review of the magnitude of the exceedances and the extent of the elevated COPC concentrations indicated that wildlife within DU06, DU07, and DU11 were unlikely to be adversely impacted. However, total HMW PAHs may pose an unacceptable risk to birds and mammals (L-HQs greater than 1 for dove, vole, robin, and shrew) and total LMW PAHs may also pose an unacceptable risk to herbivorous mammals (L-HQ greater than 1 for vole) in DU12.

6.4.3.3 Benthic Organisms

SEA01 and SEA06 were eliminated from the ERA process for benthic invertebrates based on the Tier 1 evaluation, and were not considered in Step 3a.

The potential for risks to freshwater benthic invertebrates was evaluated by comparing sediment EPCs against screening values and BTVs.

Of the three revetted SEAs evaluated in the Tier 2 screening (SEA07, SEA03, and SEA08), significant site-related risks to benthic receptors in SEA02 and SEA05 are not expected based on the comparisons to screening values and BTVs. However, the potential for risks to benthic organisms due to PCBs in SEA07 (revetted) and due to total PAHs in SEA03 and SEA08 (both classified as non-revetted) was not ruled out based on the comparisons to screening values and BTVs and these SEAs were evaluated further to characterize potential risks to the benthic invertebrate community. Although portions of SEA03 and SEA08 are revetted, both were classified as non-revetted SEAs for screening purposes in the risk assessments because the majority of the locations were identified as non-revetted during the field program.

In order to further characterize the potential for risks to benthic receptors, NYSDEC screening values for PCBs and PAHs based on probable effect concentrations were identified and an evaluation of PAH toxic units (TUs) was conducted consistent with NYSDEC (2014) and USEPA (2003b) guidance. The NYSDEC (2014) probable effect concentrations are screening values that distinguish between Class B and Class C sediments. Concentrations above the probable effect concentrations are identified as Class C sediments, which are "considered to be highly contaminated and likely to pose a risk to aquatic life" (NYSDEC 2014).

In SEA03, the total PAH EPC exceeds the NYSDEC Class C value indicating the potential risk to benthic receptors. Detected concentrations from six of the 14 locations in SEA03 exceed the Class B value (4 mg/kg), and only two locations exceed the Class C value. The concentrations above the Class B value are all located in the downstream portion of SEA03 within the DU11 boundary (locations CH-SWSD066 through CH-SWSD071). Locations upstream of DU11, including those within DU10, did not exceed the Class B value. These results indicate that only a portion of SEA03 may contain PAH levels that may adversely impact the benthic community, with only two locations above the Class C value and "likely to pose a risk to aquatic life" (NYSDEC 2014).

PAHs, like other organic chemicals, may bind to organic matter in the sediment, resulting in less observed toxicity than predicted by sediment screening values. TOC in SEA03 ranged from 6% to 35% with an average of 21%, levels that may limit some predicted PAH toxicity. Measurements of pH in surface water were below levels recommended for aquatic life, and portions of the stream dry out seasonally. Therefore, sub-optimal habitat conditions may also be impacting the benthic community in this SEA, regardless of the presence of PAHs in the sediment. A review of the PAH TUs (which consider both PAH and TOC data) identified the potential for risk to benthic receptors at the seven currently or historically revetted sampling locations.

Further characterization of PAHs was conducted for SEA03 to determine whether the PAHs were indicative of a CERCLA release. The evaluation (**Appendix C5**) indicated that total PAHs from the SEA03 revetted locations are consistent with the revetted background dataset and that the total PAHs from the non-revetted SEA03 locations are consistent with the non-revetted background dataset. The evaluation also indicated that the PAHs in SEA03 were predominantly pyrogenic, rather than petrogenic, and likely influenced by urban background sources, rather than a point source release. Given that the PAH concentrations in SEA03 are consistent with background conditions and could not be attributed to a CERCLA release, no further evaluation of PAHs in SEA03 sediment is required under CERCLA.

In SEA08, concentrations of total PAHs from ten of the 15 locations exceed the NYSDEC Class B value for total PAHs and one exceeds the Class C value. Concentrations below the Class B value are all from locations in the open wetlands in the center of the DU08 boundary. These wetland locations may be receiving discharge from east of the DU via overland flow and from a historical stream channel that was inundated at the time of Phase III sampling. The locations with concentrations above the Class B values are located within the SEA08 stream channel, which begins upstream of the DU08 boundary.

TOC in SEA08 averaged just under 4%, which may limit some predicted PAH toxicity in some locations. Measurements of pH in surface water were at the low end of the acceptable range for aquatic life, and water depths during the Phase III sampling event ranged from 2 to 12 inches. Revetments are present in the main channel along the western side of the SEA where the channel is most clearly evident and where the Class B exceedances were observed. A revetted intermittent channel crosses the open wetland from east to west, but was not visible during the Phase II sampling due to the elevated water level. Water levels within the SEA appear to be variable because DU08 was not inundated in previous sampling events, and this variability may also impact the benthic community

The PAH TU evaluation identified the potential for risk to benthic receptors at 13 sampling locations. A review of maps and site photographs indicates that nine of these samples were collected from the main stream channel which is revetted. The remaining four samples were from within the open wetland area to the east of the main channel. While the samples do not appear to have been collected from within the revetted channel that flows through the wetland, the elevated water depth at the time of sampling makes that difficult to confirm.

Similar to SEA03, an additional evaluation was conducted to determine whether the PAHs in SEA08 were indicative of a CERCLA release. The boxplots and statistical comparisons presented in **Appendix C5** indicated that total PAHs from the SEA08 revetted locations are consistent with the revetted background dataset and that the total PAHs from the non-revetted SEA08 locations are consistent with the non-revetted background dataset. The evaluation also indicated that the PAHs in SEA08, like SEA03, were predominantly pyrogenic, rather than petrogenic, and likely influenced by urban background sources, rather than a point source release. Given that the PAH concentrations in SEA08 are consistent with background conditions and could not be attributed to a CERCLA release, no further evaluation of PAHs in SEA08 sediment is required under CERCLA.

In SEA07, detected concentrations from six of the 15 locations exceed the Class B value for total PCBs. In addition, the non-detect total PCB concentrations from the remaining nine locations also exceeded the Class B value. No samples within SEA07 exceeded the Class C value. These results indicate the potential for impacts to the benthic community based on the NYSDEC screening values. Recent work by the National Oceanic and Atmospheric Administration (NOAA) on PCB toxicity to benthic invertebrates suggests that the NYSDEC screening values, and other sediment screening values available in the literature, may be overly conservative (NOAA 2016). Comparisons to alternate sediment screening values identified by NOAA (2016) indicate that, particularly when the impact of TOC is considered, risks to the benthic community in SEA07 due to exposure to PCBs are not expected.

Based on the nature and extent of the screening value exceedances and the PAH TU evaluation, benthic receptors may be at risk due to PAHs in portions of SEA03 and i SEA08. However, further characterization of the PAHs in SEA03 and SEA08 indicates that the PAHs are consistent with background conditions and could not be attributed to a CERCLA release; therefore, no further evaluation is required under CERCLA.

Based on the review of alternate literature-based screening values, and the nature and extent of the exceedances, it is determined that the benthic receptors in SEA07 are not at risk due to exposure to PCBs. Particularly when TOC is considered, PCB levels in SEA07 are below thresholds associated with significant risks to the benthic community. As with SEA03 and SEA08, habitat and water quality conditions within SEA07 may adversely impact the benthic community; however, no further evaluation of these SEAs is required under CERCLA.

6.4.3.4 Semi-Aquatic Wildlife

SEA01, SEA02, SEA04, and SEA06 were eliminated from further food web evaluation based on the results of the Tier 1 evaluation, and were not considered in Step 3a.

All Tier 2 food web HQs in SEA05 (revetted), SEA07 (revetted), and SEA08 (non-revetted) were less than or equal to 1. These results indicate significant site-related risks to birds and mammals are not expected in these exposure areas.

In SEA03 (non-revetted), N-HQs were greater than 1 for antimony and no L-HQs were greater than 1. The antimony EPC is slightly above the associated BTV. Therefore, antimony risks would be slightly above background; however, given the conservative nature of the food web model and the lack of L-HQs above 1 for antimony, sediment exposure due to antimony does not present an unacceptable risk of adverse effects to wildlife populations, although sensitive individuals may be affected.

6.4.3.5 Aquatic Organisms

SEA02, SEA03, SEA04, and SEA08 were eliminated from the ERA process for aquatic organisms based on the Tier 1 evaluation, and were not considered in Step 3a.

The potential for risks to freshwater aquatic invertebrates was evaluated by comparing surface water EPCs against screening values and BTVs.

Significant site-related risks aquatic organisms are not expected in the remaining three revetted SEAs (SEA01, SEA05, and SEA07) or the non-revetted SEA (SEA06) evaluated in Step 3a.

6.4.4 Uncertainties in the ERA

As described in more detail in Sections 3.4 and 4.4 of **Appendix N**, there are several potential sources of uncertainty in the ERA. In general, the assumptions made at multiple points in the ERA tend to err on the side of overestimating risks. The more realistic exposure assumptions made in the Tier 2, Step 3a evaluation (e.g., use of UCLs) help to refine some of these uncertainties; however, other conservative assumptions remain (e.g., chemical bioavailability and mobility).

The background evaluation and geochemical evaluation were included in the Tier 1 SLERA in order to focus the risk evaluation on COPCs that may be related to historical DoD activities at Camp Hero. The purpose of these evaluations is to avoid overestimating site-related risks by eliminating chemicals that are present based on natural conditions or on non-DoD anthropogenic sources (e.g., PAHs from atmospheric deposition or road runoff). However, the background samples may not represent the full spread of conditions observed within the DUs and SEAs (e.g., pH, TOC, hardness); therefore, some uncertainties are associated with the background evaluation. The geochemical evaluation was included to further evaluate metals relative to naturally occurring conditions. Specific uncertainties associated with the background and geochemical evaluations are discussed in **Appendix L**. The interpretation of these evaluations, particularly the geochemical correlations, is somewhat subjective but is typically based on multiple lines of evidence to avoid excluding a chemical that is truly site-related.

SEA03 and SEA08 were originally classified as non-revetted based on field observations of revetments in only a sub-set of the sampling locations (i.e., revetments were not observed at the majority of the stations). Given that these SEAs contain both revetted and non-revetted locations, comparisons to the non-revetted background dataset as part of the COPEC selection process may be overly conservative. Therefore, chemicals in revetted locations that are consistent with the revetted background dataset may have been retained as COPECs. This uncertainty is considered further in the characterization of risks to benthic organisms.

It is possible that some chemicals are present in environmental media at concentrations below analytical reporting limits, potentially resulting in an underestimate of risks. In general, the reporting limits for the COPCs expected to drive ecological risks (i.e., metals, PCBs, PAHs) are below ecological screening values, or these chemicals were detected and evaluated in the ERA. A review of the LODs for non-detect chemicals indicated that the LODs do not significantly underestimate potential site-related risks to the ecological communities.

The media-specific screening values and uptake factors represent a source of uncertainty because they are typically based on laboratory studies conducted under conditions likely to increase bioavailability (e.g., low TOC soils, bioavailable forms of the tested chemical) relative to what would likely be found under the field conditions (e.g., higher TOC, weathered chemicals). Therefore, these screening values and uptake factors may overestimate risks, and these uncertainties are considered in the characterization of risks.

In particular, when the Tier 2, Step 3a risk calculations resulted in HQs greater than 1 for terrestrial plants and soil invertebrates (indicating the potential for unacceptable risk), the basis for the screening values was reviewed, in concert with a review of the magnitude and extent of the screening value exceedances. Based on this review, it was determined that lower trophic level risks due to exposure to soil were overestimated for acetone, benzoic acid, 1,1′-biphenyl, carbazole, dibenzofuran, mercury, and for lead in DU07, arsenic and thallium in DU06, and PAHs in DU06 and DU11, and that these COPCs would not warrant further evaluation.

Other uncertainties are described in detail in Sections 3.4 and 4.4 of **Appendix N**.

6.4.5 Summary and Conclusions of the ERA

As described in **Appendix N**, the primary objective of the ERA is to evaluate whether COPCs attributable to past site activities have the potential to cause unacceptable adverse risk to ecological receptors within the area under investigation. Surface soil from 17 DUs and surface water and sediment data from eight SEAs were evaluated to assess the potential for risks to lower (soil invertebrates, terrestrial plants, aquatic invertebrates, and benthic invertebrates) and higher (birds and mammals) trophic level ecological receptors.

The potential risks were characterized using different measures of effect depending on the assessment endpoint and available data, and included evaluations of site data relative to background/natural conditions, comparisons against literature-derived toxicity screening values and evaluation of food chain modeling results. The Tier 1 SLERA concluded that certain metals, SVOCs, VOCs, and Total PCBs may pose a potential risk to plants, invertebrates, and/or wildlife.

The Tier 2, Step 3a ERA reevaluated the Tier 1 COPCs to identify and eliminate from further consideration those COPCs that were retained because of the use of very conservative Tier 1 exposure scenarios. This step considered alternate EPCs, a refinement of wildlife exposure factors and ERVs, and a discussion of the conservatism and uncertainties associated with several of the direct contact screening values. The results of the Tier 2, Step 3a evaluation are summarized below.

For soil invertebrates and terrestrial plants, HQs are greater than 1 for several inorganic and organic COPCs. However, there are significant uncertainties about the true bioavailability and toxicity of these COPCs to plants and invertebrates. Based on a review of the screening value sources and additional toxicity information, and given the relatively low magnitude of the exceedances and infrequency of the exceedances, risks to plants and soil invertebrates are expected to be overestimated and insufficient to warrant carrying these COPCs further in the ERA process.

An exception to plant and invertebrate risk is that PAHs in surface soil may pose an unacceptable risk in DU12. Concentrations of total HMW PAHs and total LMW PAHs were well above the associated soil invertebrate Eco-SSLs and the BTVs. Although more uncertainties are associated with the plant-based screening values (i.e., USEPA did not derive Eco-SSLs for plants), individual PAHs frequently exceeded the available plant screening values. Although exposure to PAHs in DU12 surface soil may pose an unacceptable risk to plants and soil invertebrates, further characterization of PAHs in the DU12 surface soil samples (**Appendix C5)** indicates that the PAHs could not be attributed to a CERCLA release and no further evaluation is warranted.

Terrestrial wildlife HQs were greater than 1 for individual PAHs, total HMW PAHs, total LMW PAHs in DU06, DU11, and DU12, and lead in DU07. However, as discussed in Section 4.0 of **Appendix N**, a review of the magnitude of the exceedances and the extent of the elevated COPC concentrations indicated that wildlife within DU06, DU07, and DU11 were unlikely to be adversely impacted. However, total HMW PAHs may pose an unacceptable risk to birds and mammals (L-HQs greater than 1 for dove, vole, robin, and shrew) and total LMW PAHs may also pose an unacceptable risk to herbivorous mammals (L-HQ greater than 1 for vole) in DU12. As indicated above, further characterization of PAHs in the DU12 surface soil samples indicates that the PAHs could not be attributed to a CERCLA release and no further evaluation is warranted. It is noted that, although the PAH HQs are higher in DU11 than in DU12, the DU11 EPC and associated risks are driven up by one elevated concentration representing pyrogenic PAHs not associated with a CERCLA release (e.g., creosote or coal tar). Therefore, adverse impacts to foraging birds and mammals in DU11 are expected to be overestimated, and no further evaluation is warranted.

Although benthic receptors may be at risk due to exposure to total PAHs in portions of SEA03 and SEA08, an evaluation of total PAH concentrations relative to the revetted and non-revetted background datasets indicates that the PAHs in both SEA03 and SEA08 are consistent with background conditions and could not be attributed to a CERCLA release. Therefore, no further evaluation of PAHs in sediment from SEA03 or SEA08 is warranted.

PCBs detected in SEA07 are not expected to pose a significant risk to the benthic community. A review of alternate PCB screening values indicates risks to benthic invertebrates are overestimated by the threshold effect-based screening value and that, particularly when TOC is considered, PCB levels in SEA07 are below thresholds associated with significant risks to the benthic community. As with SEA03 and SEA08, habitat and water quality conditions within the SEA may adversely impact the benthic community; however, no further evaluation of SEA07 is warranted.

Risk to semi-aquatic wildlife populations from sediment is considered acceptable with all L-HQs less than 1. Antimony in SEA03 may present a risk to individual small mammals (represented by the vole and shrew) with N-HQs greater than 1. However, risk to semi-aquatic wildlife populations is considered acceptable with all L-HQs less than 1.

No unacceptable risks to aquatic organisms due to exposure to COPCs in surface water were identified.

Based on the results of the Tier 2 Step 3a evaluation, , no chemicals of concern were identified for further evaluation under CERCLA.

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7.0 SUMMARY AND CONCLUSIONS

The primary objectives of this RI Report are to identify and summarize the nature and extent of potential releases and impacts in site media from former military operations, and to subsequently quantify whether unacceptable risks are posed to human health or ecological receptors associated with exposure to chemicals from these historical operations.

As indicated in Section 1.3, the RI began with a comprehensive review of available information prior to the start of field investigations. The records review identified 45 potential AOCs at Camp Hero, which included former waste disposal areas, former coal storage areas, abandoned drum locations, possible and former USTs, former ASTs, and a Motor Pool building, among others. Findings from the records review are documented in the Final Technical Memorandum (Records Review January 2016), which is included as **Appendix D**. Two additional AOCs were established during field investigation, for a total of 47 AOCs investigated.

Three sequential phases of field investigation (Phase I, II, and III) were conducted as part of this RI. The Phase I was conducted as a CERCLA SI-level investigation, with the field work conducted between 16 May and 24 June 2016. The primary objective of the Phase I RI field investigation was to determine the presence or absence of potential impacts from former DoD activities at each of the AOCs. The sampling design for the Phase I program consisted of discrete, biased sampling to target the most likely potential source areas. Phase I activities included a geospatial survey of archived aerial photography, digital geophysical mapping of select AOCs, collection of biased surface and subsurface soil samples for use in the PSE, and collection of grab (unfiltered) groundwater samples for use in refining the groundwater CSM.

The Phase II RI field investigation was conducted between 28 November and 16 December 2016. The primary objective of the Phase II RI field investigation was to evaluate the extent of residual LNAPL present and related chemicals at the former Building 203 AOC (currently included as part of DU01). The Phase II RI field investigation activities also included the installation, development, and sampling of 15 permanent background monitoring wells for the collection of a sitewide background groundwater data. Phase II activities at the former Building 203 AOC consisted of subsurface screening for LNAPL with LIF; unbiased surface soil sample collection; biased subsurface soil sampling to further evaluate the extent of LNAPL; and groundwater sample collection from six newly-installed permanent monitoring wells. Additionally, a sitewide surface water drainage survey and habitat surveys of multiple AOCs were conducted.

After completion of the Phase II investigation, the PSE was completed using the biased Phase I and II RI datasets to determine which AOCs require further assessment and to refine the list of parameters for sample collection during the final phase of investigation. AOCs that warranted further assessment were grouped into 18 geometric DUs, and streams in the vicinity of the DUs were grouped into eight SEAs for the assessment of surface water and sediment.

The Phase III RI field investigation was conducted between 30 May and 28 June 2017. The primary objective of the Phase III RI field effort was to complete the RI phase of the CERCLA process by collecting an unbiased, representative dataset for potentially impacted surface and subsurface soil associated with each of the individual DUs; collecting a representative background dataset for surface water and sediment at a sitewide scale; collecting unbiased, representative surface water and sediment data in exposure areas the vicinity of DUs that could potentially impact downgradient surface water and sediment; establishing a representative groundwater monitoring well network and collect groundwater samples on a sitewide scale, as well as on a local scale in the vicinity of DUs that could potentially have localized groundwater impacts; and collecting additional physical and chemical data to support the CSM, risk assessments, and the potential evaluation of remedial alternatives, if required. The Phase III effort was specifically designed to support the risk assessments and address data gaps from previous phases.

Additionally, a potability analysis was conducted as part of the RI and it was concluded that the perched groundwater lenses beneath Camp Hero are not hydraulically connected to drinking water resources in Suffolk County. There is no indication that the deep aquifer beneath Camp Hero, which is separated from the perched groundwater lenses by a continuous confining layer of 100 to 130 feet thick, has been compromised by FUDS activities. The perched groundwater lenses beneath Camp Hero are also discontinuous and could not be used for potable purposes.

The objectives of each phase of field investigation were met and the field programs have comprehensively characterized the nature and extent of contamination and the risk assessments have quantified potential risks. The following sections present a summary of the nature and extent of contamination, the fate and transport properties of the specific chemicals that contributed most to potential risks, and the results of the HHRA and the ERA. The final conclusions and recommendations are provided in Section 7.4.

7.1 Nature and Extent of Contamination

This discussion of nature and extent of contamination for the Camp Hero RI focused on the specific media and chemicals that contributed most to potential risks, as determined in the HHRA and ERA. As presented in Section 6.0, benzo(a)pyrene in surface soil at DU11 could pose potential human health risks to the construction worker. At DU12, benzo(a)pyrene and total BaP PAHs in surface soil could pose potential human health risks to the adult and child recreational users. Additionally, total HMW and total LMW PAHs in surface soil at DU11 and DU12 could potential ecological risks to plants, soil invertebrates, birds, and mammals. At SEA03 and SEA08, total PAHs in sediment could pose potential ecological risks to benthic invertebrates. Therefore, the nature and extent of contamination discussion for Camp Hero focused on PAHs in surface soil and sediment.

At DU11, detections of benzo(a)pyrene in surface soil ranged from 0.031 mg/kg to 180 mg/kg, with the maximum detection at DU11-S003. The surface soil EPC for benzo(a)pyrene was strongly influenced by the DU11-S003 concentration of 180 mg/kg, as the remaining concentrations ranged from 0.031 mg/kg to only 1.7 mg/kg. The concentrations of total HMW PAHs ranged from 0.30 mg/kg to 1500 mg/kg, while the concentrations of total LMW PAHs ranged from 0.12 mg/kg to 1600 mg/kg. The maximum detection for both LMW and HMW PAHs was also at location DU11-S003. Location DU11-S003 was placed near the back (south) side of former Building 034.

At DU12, concentrations of the PAH totals generally increased with proximity to Coast Artillery Road. The concentrations of benzo(a)pyrene in surface soil ranged from 0.043 mg/kg to 150 mg/kg. The concentrations of total BaP PAHs in surface soil at DU12 ranged from 0.063 mg/kg to 220 mg/kg, and were driven by the concentrations of benzo(a)pyrene. The concentrations of total HMW PAHs in surface soil ranged from 0.34 mg/kg to 1300 mg/kg and the concentrations of total LMW PAHs in surface soil ranged from 0.16 mg/kg to 1100 mg/kg. The maximum detections of PAHs were typically at location DU12-S001; additionally, the maximum detection of total LMW PAHs was also detected DU12-S008. DU12-S001 was located along the north side of Coast Artillery Road near the entrance to the park maintenance and brush storage area. DU12-S008 was located near the concrete foundation along the south side of Coast Artillery Road.

At SEA03, concentrations of total PAHs in sediment at SEA03 ranged from 0.13 mg/kg to 71 mg/kg. The highest concentrations of total PAHs were located in the downstream portion of SEA03 within the DU11 boundary (locations CH-SWSD066 through CH-SWSD071). The maximum detected concentration was at CH-SWSD066, the furthest downgradient sample location within SEA03. At SEA08, concentrations of total PAHs in sediment at SEA08 ranged from 0.57 mg/kg to 61 mg/kg. Concentrations of PAHs in the stream area were higher than concentrations in the inundated pond area, with the maximum detected concentration at location CH-SWSD146 in the stream area.

A review of the PAH ratios for the most elevated DU11 sample (DU11-S003) indicated that the sample is pyrogenic and may represent creosote or coal tar which would not be associated with a CERCLA release (**Appendix M and N**). An additional characterization of PAHs associated with DU12 surface soil and sediment from SEA03 and SEA08 indicated that the PAHs in these areas are not attributed to a CERCLA release. Additional characterization of PAHs presented in **Appendix C5** indicated that the PAHs in these areas are dominated by pyrogenic PAHs and likely to be influenced by urban background contributions rather than point sources. Soil boring logs for DU12 also indicated evidence of demolished asphalt parking lot materials. In SEA03 and SEA08, the PAHs in the revetted portions of SEA03 and SEA08 were not significantly higher than in the background revetted dataset.

At DU01, LNAPL was discovered during the Phase I effort in the subsurface near the edge of the former UST 16 and 18 pit excavation. During the subsequent phases of field investigation, the vertical and horizontal extent of LNAPL at DU01 was delineated. Although there is some mobile LNAPL at the site, the LNAPL appears to be stable. The LIF borings show that there is a large vertical smear zone indicative of residualization of the LNAPL due to perched groundwater level fluctuations. LNAPL transmissivity estimated from bail-down tests are consistent with the overall findings that the LNAPL is stable and not recoverable. The weathered LNAPL sample suggests that NSZD processes are active at the site and are actively depleting the LNAPL source. Despite the presence of LNAPL in the subsurface, none of the COPCs in soil, groundwater, surface water, or sediment at DU01 were identified as COCs after the completion of the HHRA and ERA.

7.2 Fate and Transport

The fate and transport evaluation at Camp Hero focused on PAHs, which were the only parameters found to contribute to potential site-specific risks (additional details in Section 6.0). PAHs are a group of chemicals found throughout the environment primarily as a result of the incomplete combustion of organic substances. Because DU12 and SEA03 are in close proximity to Coast Artillery Road, the most likely sources of PAHs at those DUs and SEAs are vehicle exhaust and emissions, weathering of asphalt roads and tires, coal tar (potentially used as roadway seal coating), and ongoing road maintenance. This finding was supported by the additional characterization of PAHs (**Appendix C5**), which indicated that PAHs in these areas are dominated by pyrogenic PAHs and appear to be influenced by urban background contributions, rather than point sources.

Additionally, the wooden revetments used to channelize surface water flow within streams may contribute to the total PAH concentrations in SEA03 and SEA08. A review of the sediment data for these SEAs and the background areas indicates that concentrations of PAHs are typically higher in revetted stream segments than in non-revetted streams. The additional background evaluation (**Appendix C5**) confirmed that the concentrations of total PAHs in the revetted portions of SEA03 and SEA08 were not higher than the revetted background dataset. Therefore, it is likely that the PAHs found in all SEAs are associated with the presence of the revetments.

SEA08 is located at the terminus of the Camp Hero surface water drainage system and receives storm water discharge from the entire eastern half of the site. PAHs from the previously-listed sources likely migrate into nearby streams and travel through the drainage system to SEA08, prior to discharge to the Atlantic Ocean.

PAHs deposited onto soil have a tendency to bind to organic carbon, while PAHs deposited onto surface water have a tendency to bind to organic carbon particles suspended in the water column and then settle into the sediment. The primary transport mechanisms for PAHs at Camp Hero are the storm water erosion of surface soil particulates and movement of sediment-bound chemicals during periods of increased flow related to high rain events. The distribution of chemicals generally reflects these processes at SEA08, with higher concentrations of PAHs detected in the drainage channel compared to the adjacent pond area.

7.3 Risk Assessment

Human health and ecological risk assessments were completed per the CERCLA process to evaluate potential risks posed to current and theoretical future human health receptors, as well as ecological receptors. Potential risks may be posed to current and theoretical future human health receptors, as well as terrestrial and benthic receptors. COPCs were quantitatively evaluated in the HHRA and the ERA following an initial risk screening process, background evaluation, and geochemical evaluation. The following sections present a summary of the HHRA and ERA findings.

Human Health Risk Assessment

The HHRA quantitatively evaluated exposure by human receptors to soil, groundwater, surface water, and sediment through incidental ingestion, dermal contact, and inhalation of wind-blown particulates and vapors at each DU, SEA, and sitewide groundwater.

The HHRA evaluated the following current and future on-site exposure scenarios:

- Current youth trespasser
- Current and future park employee
- Current and future outdoor maintenance worker
- Current and future recreational user (child, adult, and lifetime)
- Future construction worker
- Future indoor worker
- Future hypothetical resident (child, adult, and lifetime)

With the exception of DU11 and DU12, the estimated ELCR and non-cancer hazard results for the non-residential receptors evaluated at Camp Hero were below the USEPA target cumulative ELCR and non-cancer hazard thresholds (i.e., 1E-04 and 1, respectively). The following chemicals at DU11 and DU12 caused the cumulative ELCR and HI estimates to exceed 1E-04 or a target organ-specific HI greater than 1:

- Even though benzo(a)pyrene was identified as a risk driver for surface soil at DU11 for the on-site construction worker, the weight-of-evidence evaluation indicated that the risk results were likely overestimated. Also, PAHs in surface soil at DU11 were influenced by elevated concentrations of PAHs in a single surface soil sample which may represent creosote or coal tar which would not be associated with a CERCLA release. Benzo(a)pyrene in surface soil at DU11 was eliminated from further evaluation.

- Even though benzo(a)pyrene and total BaP PAHs were identified as risk drivers in surface soil at DU12 for the current on-site child recreational user, the weight-of-evidence evaluation and the additional characterization of PAHs at Camp Hero indicated that the risk results were likely overestimated and the PAHs present in DU12 surface soil were not attributed to a CERCLA release. Soil boring logs for DU12 also indicated evidence of demolished asphalt parking lot materials. Benzo(a)pyrene and total BaP PAHs in surface soil at DU12 were eliminated from further evaluation.

The current and expected future land use of the park is recreational. However, the inclusion of a hypothetical future resident in the HHRA was used to conservatively evaluate UU/UE for future risk management decision-making, should the land use change. The hypothetical resident risk results are briefly summarized below.

- The Camp Hero potability analysis (**Appendix K**) revealed that the shallow perched groundwater at Camp Hero was not suitable as a potable water source. However, the drinking water exposure pathway was still quantitatively evaluated even though the drinking water exposure pathway is considered incomplete.

- The estimated cancer risks and non-cancer hazards for a hypothetical resident scenario were above USEPA target risk thresholds at DU01, DU11, DU12, DU14, STB, and sitewide groundwater. Exposure to shallow groundwater was the primary exposure medium of concern; metals, PAHs, and VOCs were identified as the primary risk drivers due to the ingestion of groundwater as drinking water as well as inhalation of vapors while showering/bathing and in indoor air (vapor intrusion).

- The hypothetical on site resident was evaluated in the HHRA for informational purposes only and were not used to identify COCs requiring remediation.

Ecological Risk Assessment

The ERA quantitatively evaluated surface soil from 17 DUs and surface water and sediment data from eight SEAs to assess the potential for risks to lower (soil invertebrates, terrestrial plants, aquatic invertebrates, and benthic invertebrates) and higher (birds and mammals) trophic level ecological receptors. The potential risks were characterized using different measures of effect depending on the assessment endpoint and available data, but included evaluations of site data relative to background/natural conditions, comparisons against literature-derived toxicity screening values, and evaluation of food chain modeling results. The results of the Tier 2, Step 3a evaluation are summarized below.

For soil invertebrates and terrestrial plants, HQs are greater than 1 for several inorganic and organic COPCs. However, there are significant uncertainties about the true bioavailability and toxicity of these COPCs to plants and invertebrates. Based on a review of the screening value sources, additional toxicity information, and the magnitude and frequency of the exceedances, risks to plants and soil invertebrates are expected to be overestimated and insufficient to warrant carrying these COPCs further in the ERA process. An exception to this finding is that PAHs in surface soil may pose a potential risk to plants and invertebrates in DU12.

Terrestrial wildlife HQs were greater than 1 for individual PAHs, total HMW PAHs, and total LMW PAHs in DU06, DU11, and DU12, and for lead in DU07. However, a review of the magnitude and extent of the exceedances indicated that wildlife within DU06, DU07, and DU11 were unlikely to be adversely impacted.

The ERA indicated that total HMW PAHs could pose a potential risk to insectivorous and herbivorous birds and mammals at DU12, and total LMW PAHs could pose a potential risk to herbivorous mammals in DU12. However, further characterization of PAHs in the DU12 surface soil samples (**Appendix C5**) indicates that the PAHs could not be attributed to a CERCLA release and no further evaluation is warranted.

Additionally, total PAHs could pose a potential risk to benthic receptors in portions of SEA03 and SEA08. In both of these SEAs, habitat conditions such as shallow water or low pH may also adversely impact the benthic community, and organic carbon may reduce some predicted PAH toxicity. Further characterization of the PAHs at SEA03 and SEA08 indicated that the PAHs are consistent with background conditions and are not attributed to a CERCLA release (**Appendix C5**). Therefore, no further evaluation of PAHs in sediment from SEA03 or SEA08 is warranted.

7.4 Conclusions and Recommendations

The RI phase of the CERCLA process for Camp Hero is complete. This RI report is comprehensive in presenting the information that contributed to scoping the RI phases of investigation and presenting the results of the RI phases of investigation. This report includes detailed appendices for references, figures and tables on a sitewide and DU/SEA-specific scale, background and geochemical evaluations, a field report and associated documentation for each phase of field investigation, an evaluation of groundwater potability, and the human health and ecological risk assessments.

Based on the completion of the RI phase of work and in accordance with the CERCLA process, NFA is recommended for all DUs and SEAs established for the Camp Hero RI. Although the risk assessments indicated potential risks could be posed to receptors from PAHs at DU12, SEA03, and SEA08, further characterization of the PAHs indicated they are not attributed to a CERCLA release. Therefore, no further assessment or response action is warranted for the investigation areas at Camp Hero under the CERCLA program. **Table 7-1** presents an overall summary of the AOCs that were identified at the beginning of this RI, their grouping into the respective DUs and SEAs assessed, and the recommended path forward for each.

Because COCs were not identified at DU01 during the risk evaluation, additional action for DU01 is not required under the CERCLA program. However, a NYSDEC Pollution Complaint Number (PC-1602757) is open for the LNAPL delineated identified at the former Building 203 (DU01). Therefore, the LNAPL at DU01 will be addressed under the NYSDEC Spills Response Program in accordance with Article Twelve of the New York State Navigation Law. The 1993 site remediation efforts (over excavation and off-site disposal of soil at the USTs), LNAPL stability, lack of recoverability, and evidence of active source depletion will be taken into consideration when evaluating whether further action is required under the NYSDEC program.

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