FINAL

RECORD OF DECISION

CCFTBR-H

FORT LIBERTY/FAYETTEVILLE, CUMBERLAND COUNTY, NORTH CAROLINA

January 2024

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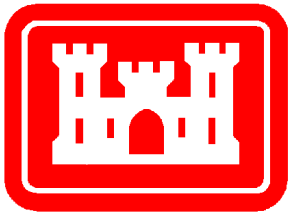

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LIST OF ACRONYMS

AFB	Airforce Base
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulation
COPC	Contaminants of Potential Concern
COC	Contaminant of Concern
CSM	Conceptual Site Model
CY	Cubic Yards
DOD	Department of Defense
DPW	Directorate of Public Works
ERA	Ecological Risk Assessment
ESD	Explanation of Significant Differences
FS	Feasibility Study
FYR	Five Year Review
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
HRC	Hydrogen Release Compound
IC	Institutional Control
IRP	Installation Restoration Program
LTM	Long-term Monitoring
NCAC	North Carolina Administrative Code
NCDEQ	North Carolina Department of Environmental Quality
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
O&M	Operations and Maintenance
PP	Proposed Plan
PRSG	Preliminary Remedial Soil Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SP	Screen Point
SRI	Supplemental Remedial Investigation
SVOC	Semi-Volatile Organic Compounds
TBC	To Be Considered
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
VOC	Volatile Organic Compound

Part 1: DECLARATION

Site Name and Location

CCFTBR-H Site (Site) is located in the northern portion of Fort Liberty, North Carolina near the intersection of Rock Merritt Avenue and Sidewinder Street. The site consists of approximately 2 acres in Cumberland County. The site includes Building 192 which was used for golf cart parking, maintenance, and chemical storage for the Pope Army Airfield Golf Course (formerly Pope AFB Golf Course) from the early 1970s until 2012. A Site Vicinity Map is included as Figure 1 and the Site Layout is included as Figure 2.

Statement of Basis and Purpose

This decision document presents the Selected Remedy for CCFTBR-H, in Fort Liberty, Cumberland County, North Carolina, which was chosen in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1990 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The decision presented in this Record of Decision (ROD) is based on information contained in the Administrative Record (AR) file for site CCFTBR-H. Information not specifically summarized in this ROD or its references, but contained in the AR, has been considered and is relevant to the selection of the remedy at CCFTBR-H. Thus, the ROD is based on materials in the AR file, and the entire AR file was relied upon in making the decision. The AR file is available for review at:

Cumberland County Public Library
300 Maiden Lane
Fayetteville, NC 28301

The Installation Restoration Program (IRP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. No enforcement activities have been noted at Site CCFTBR-H. The Army is the lead agency and provides funding for CERCLA response actions at Fort Liberty. The remedy set forth in this ROD has been selected by the Army. The State of North Carolina and the North Carolina Department of Environmental Quality (NCDEQ), the support regulatory agency, concurs with the Selected Remedy.

Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare of the environment from actual or threatened releases of hazardous substances into the environment.

Description of the Selected Remedy

The Selected Remedy in this ROD will address the contaminated media at the Site. The Army, with consultation from NCDEQ, has determined that the Selected Remedy for the Site will be the most effective approach for addressing contamination of the soil and groundwater.

The Selected Remedy for the Site consists of the following components:

- Excavation and removal of contaminated soils that exceed residential or ecological cleanup levels;
- Disposal of soils in an offsite permitted Resource Conservations and Recovery Act (RCRA) Subtitle C or D landfill, depending on waste characterization;
- Backfilling with imported clean soil suitable for residential use;
- In-situ groundwater treatment with Hydrogen Release Compound (HRC) and micro-scale carbon amendments; and
- Groundwater monitoring until levels are below North Carolina Groundwater Quality Standards in 15A North Carolina Administrative Code (NCAC) 02L (NC2L) for four consecutive events.

Statutory Determination

The Selected Remedy meets the requirements for remedial actions set forth in Section 121 of CERCLA, 42 U.S.C § 9621, and the NCP at 40 Code of Federal Regulations (CFR) § 300.430(f)(1)(ii) because it: 1) is protective of human health and the environment; 2) complies with applicable or relevant and appropriate requirements (ARARs); 3) is cost effective; and 4) uses permanent solution and alternative treatments (or resource recovery) technologies to the maximum extent practicable. Because this remedy may result in hazardous substances, pollutants, or contaminant remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

ROD Data Certification Checklist

The following information is included in the Decision Summary (Part II) of this ROD. Additional information can be found in the AR for the Site.

ROD CERTIFICATION CHECKLIST	
COCs and respective concentrations	Section 5.3, page 15-16
Baseline risk represented by COCs	Section 7.0, page 16-19
Cleanup levels established for COCs and the basis for these levels	Section 8.0, page 19
How source materials constituting principal threat are addressed	Section 11.0, page 29

Current and reasonably anticipated future land assumptions and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD	Section 6.0, page 16
Potential land use that will be available at the Site as a result of the Selected Remedy	Section 6.0, page 16
Estimated capital, annual Operations and Maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	Section 12.3, page 31
Key factors that led to selecting the remedy	Section 12.0, page 29-31

Authorizing Signatures

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11 MAR 2024

John M. Wilcox, Colonel, U.S. Army
Garrison Commander

Date

5/09/24

Michael E. Scott, NCDEQ
Director, Division of Waste Management

Date

II. DECISION SUMMARY

CCFTBR-H

FORT LIBERTY, CUMBERLAND COUNTY, NORTH CAROLINA

II. Decision Summary

1.0 Site Name, Location, and Description

The Site is located in the cantonment area of Fort Liberty, Cumberland County, North Carolina. The City of Spring Lake is approximately 1-mile east of the Site. The Site is bounded to the north by Sidewinder Street, to the south and east by an intermittent stream, wetlands, paved areas, and to the west by Rock Merritt Avenue (Figure 1).

The Army is the lead agency with NCDEQ being the supporting agency for the Selected Remedy. Funding is being provided by the Department of Defense (DOD) to implement the Selected Remedy.

2.0 Site History and Enforcement Actions

There is no record of CERCLA enforcement activities at the Site.

2.1 History of Contamination

The Site includes a former storage and maintenance building, Building 192, that was used for golf cart parking and maintenance, former Building 193 which was used as the golf course pro shop, and chemical and pesticide storage (Figure 2). Building 192 and Building 193 were in use as part of the Pope Army Airfield Golf Course (formerly Pope AFB Golf Course) from the early 1970's until 2012 when the golf course closed. Mechanisms related to the release of the contaminants is unknown. Probable release mechanisms would include: spills and leaks from containers, spills and leaks when filling spray tanks, cleaning of the tanks used to apply the pesticides, and application of pesticides under the foundation of Building 193.

2.2 Previous Environmental Investigations

In December 2011, the Fort Liberty Directorate of Public Works (DPW) conducted soil sampling in the vicinity of Building 192. The soil samples were collected from 0-6 inches below ground surface (bgs) and analyzed for organochlorine pesticides by Environmental Protection Agency (EPA) method 8081A. Aldrin and dieldrin were detected in six of the soil samples above the EPA Regional Screening Levels (RSLs).

After the golf course was closed in 2012, the U.S. Army Corps of Engineers (USACE) Savannah District collected soil samples course-wide to determine if there was

contamination related to prior application and storage of pesticides. The samples collected as part of this study were analyzed for Resource Conservation and Recovery Act (RCRA) Metals by EPA method 6010C/7471A and organochlorine pesticides by EPA method 8081B (USACE, 2012). This sampling was divided into three events, February 2012, May 2012, and August 2012.

The February 2012 event consisted of the collection of 21 soil samples from 0-6 inches bgs distributed across the golf course. All of the sample results were below the EPA RSLs.

In May 2012, an additional 12 surficial soil samples were collected adjacent to Building 192. Three soil samples were found to exceed the EPA RSL for aldrin and dieldrin.

Based on the data of the prior two sampling events by the USACE, additional samples were collected in August 2012 to determine the extent of pesticide contamination in the vicinity of Building 192. During this sampling event, 11 soil samples were collected up to a depth of 2-feet bgs. The vertical extent of the contamination was not determined as three locations had detections of pesticides above the EPA RSL at 2-feet bgs.

In 2015, Bay West was contracted to delineate the extent of soil and groundwater contamination and to complete an RI/FS (Bay West, 2016). The soil and groundwater investigation was completed in three phases, June 2015, October 2015, and February 2016. The extent of soil contamination found during this investigation is presented on Figure 3.

During the first phase of investigation in June 2015, groundwater was evaluated by the installation of a temporary well, MW-01; this location is near the center of the suspected source area (Figure 3). The results from a sample collected at this location had detections of dieldrin exceeding the NC2L. Soil samples collected in the vicinity of MW-01 verified contamination in this area identifying it as the source area.

The second phase of investigation was conducted in October and November 2015. Additional soil and groundwater samples were collected, MW-01 was converted to a permanent monitoring well, and four temporary monitoring wells were installed. The temporary wells were installed to screen for detections of contaminants of concern. Detections of aldrin and dieldrin at the four temporary monitoring well locations were found to be above the NC2L standard. Groundwater samples were collected in November 2015 to assess the potential for an oil-based carrier solvent by analyzing samples for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). The laboratory data did not indicate the presence of an oil-based carrier solvent. Soil samples

collected during this phase indicated that the soil contamination had been delineated as no detections were above the U.S. EPA Residential Soil Screening Levels.

The third phase of investigation was conducted in February 2016. This included the installation of three permanent monitoring wells. The newly installed wells were developed and allowed to stabilize and equilibrate with the aquifer prior to sample collection. Filtered and unfiltered groundwater samples were collected from the three wells. Samples from monitoring wells FTBR-H-MW-01 and FTBR-H-MW-04, filtered and unfiltered, indicated that pesticides were present above the NC2L standard. Based on the results of the groundwater sampling, it was determined that additional investigation was needed to fully delineate the groundwater contamination. Based on the data from the previous investigations, cross sections were completed which can be found on Figures 4 and 5.

The USACE mobilized a field crew to the site in February, March, and May of 2018 to delineate the groundwater plume using twenty-one temporary well locations. These temporary wells were installed between 18-28 feet bgs. The groundwater samples were analyzed for organochlorine pesticides by EPA Method 8081B (USACE, 2018).

During the February 2018 sampling event, 12 screen point (SP) locations, FTBRH-SP-01 through FTBRH-SP-12, were sampled for organochlorine pesticides. Screen point locations are used for screening but frequently lead to higher results due to the samples having a high turbidity. Dieldrin was detected at estimated concentrations in four of the locations sampled: FTBRH-SP-06, FTBRH-SP-08, FTBRH-SP-09, and FTBRH-SP-10. All four dieldrin detections exceed the NC2L standard of 0.002 µg/L. Of the remaining eight locations sampled, there were no detections of dieldrin. None of the sampled locations had detections of aldrin.

Sampling in March 2018 saw the installation of five additional temporary well locations, FTBRH-SP-13 through FTBRH-SP-17. Of these five locations, FTBRH-SP-16 and FTBRH-SP-17 had detections of dieldrin above the NC2L standard of 0.002 µg/L. Of the remaining three locations sampled, there were no detections of dieldrin. None of the sampled locations had detections of aldrin. All detections had J-flags indicating the value was estimated by the laboratory.

NCDEQ requested that additional samples be collected in the vicinity of Building 236 based on the results of the March 2018 sampling. In May 2018, four additional locations, FTBRH-SP-18 through FTBRH-SP-21, were sampled for organochlorine pesticides. Dieldrin was detected at three of the four locations. The three detections exceeded the NC2L standard of 0.002 µg/L. None of the sampled locations had detections of aldrin.

The report concluded that based on site topography, the detections were upgradient of the golf course and are not associated with the site and it was recommended to install three monitoring wells at the site. These monitoring wells were installed in October 2018 and sampled as part of the Supplemental Remedial Investigation (SRI) completed in 2020.

The SRI was completed to document the changes in the site since completion of the RI and present sampling completed in 2020. In February 2020, the eight monitoring wells at the site were sampled for Aldrin and Dieldrin pesticides by EPA Method 8081B. Sampling of the monitoring wells was conducted using low-flow sampling methods. FTBR-H-MW-01 was the only well with a detection of dieldrin (0.161 µg/L) above the NC2L standard of 0.002 µg/L.

Based upon the information collected during the SRI, it was determined that the Human Health Risk Assessment (HHRA) was still applicable for decision making purposes. The conclusion was based upon the concentrations being lower during the SRI sampling, no changes to the risk characteristics, and the same regulatory criteria. At the completion of the SRI, groundwater had been fully delineated.

In May 2023, additional sampling was completed at that site based on a recommendation in the Proposed Plan. This sampling event collected groundwater samples from the monitoring wells to be analyzed for VOCs by EPA Method 8260D and Organochlorine Pesticides by EPA Method 8081B. During this sampling, Dieldrin, gamma-BHC, and alpha-Chlordane was detected above the applicable NC2L standard in unfiltered samples. In filtered samples, only Dieldrin and Aldrin were detected at FTBRH-MW-01 above the NC2L. The only VOC detected was 2-methylnaphthalene below the NC2L. The groundwater concentrations and groundwater elevations and flow are depicted on Figures 6 and 7 respectively. Based on the detections outside of the suspected source area being only in the unfiltered samples, the turbidity is a likely contributor to exceedances in unfiltered samples. This would indicate that this is not part of site contamination and is highly probable that the pesticides being detected due to turbidity is related to approved and appropriate usage during past pesticide applications.

3.0 Community Participation

On December 16. 2022, pursuant to Section 113(k)(2)(B) of CERCLA 42 U.S.C §9613(k)(2)(B), the Army released the Proposed Plan (PP) for CCFTBR-H for a 30-day public comment period. The Proposed Plan was based on documents contained in the AR for the Site and set forth the Army’s preferred remedial alternative. During the public comment period, the Army accepted written comments, but none were received. Oral

comments could also be submitted via phone and voicemail, but none were received. This community participation activity meets the public participation requirements in CERCLA Section 117, 42 U.S.C §9617, and 40 C.F.R. §300.430(f)(3) of the NCP.

The AR can be found in the Cumberland County Public Library at 300 Maiden Lane, Fayetteville, North Carolina, 28301. The Proposed Plan was also made available online through the USACE website. The notice of the availability of these documents was published in the Fayetteville Observer on December 16, 2022. The Public Comment period was held from December 16, 2022, through January 23, 2023.

4.0 Scope and Role of Operable Unit

This site does not have operable units.

5.0 Site Characteristics

This section of the ROD provides an overview of the Site's geology and the nature and extent of the contamination. Additional information regarding the nature and extent of contamination can be found in the AR.

5.1 Overview of the Site

The Site is located in the cantonment portion of Fort Liberty, Cumberland County, North Carolina. The Site includes a former golf cart maintenance and pesticide storage area (Building 192) that operated from the early 1970's until 2012. Building 192 still exists at the Site. Soil and groundwater at the site have been affected by contamination. Topographically, the site is bound on the west by a hill that slopes to the east and an unnamed stream flows southwest to the northeast. The site has a slope to the east and southeast. An area along the stream is denoted as wetlands on the Fort Liberty GIS layer adjacent to the site to the south.

5.2 Geology and Hydrology

5.2.1 Regional Geology

Fort Liberty is located in the coastal plain region of North Carolina in the Piedmont Provence which is part of the larger Appalachian Highlands physiographic region.

Most of Fort Liberty (approximately 90%) is underlain by the Upper Cretaceous Tuscaloosa Group. The Tuscaloosa Group is alluvial in origin and overlies the crystalline

basement rocks of the Piedmont. The Piedmont is the remnant of several ancient mountain chains that have since been eroded away. The Tuscaloosa Group varies in thickness from 21 to 122 meters and is subdivided into two formations (A.T. Kearney, Inc. and DPRA, Inc., 1988). The northeast portion of Fort Liberty, including the location of the Site, may be underlain by Carolina Slate Belt. The Carolina Slate Belt consists mostly of volcanic and sedimentary rocks that have undergone low-grade metamorphism. The area is cut in several places by coarse-grained undeformed intrusive granites. The Carolina Slate Belt is overlain by the Cape Fear Formation consisting of interbedded clays and sands. The Cape Fear Formation is overlain by the Middendorf Formation consisting of fluvial-deltaic sands and clays (USGS, 2023).

5.2.2 Site Geology and Hydrology

Based on borings completed at the site, the geology at the site consists of tan to dark brown fine-grained sand to a depth of approximately 24-feet bgs underlain by a gray clay. Borings were completed to a maximum of 25-feet bgs. Groundwater typically occurs within sand and gravel with the depth to groundwater ranging from approximately 6-feet bgs to 11-feet bgs. The Middendorf Aquifer is the impacted aquifer at the site. Groundwater direction is variable at the site, but the last two events had groundwater flowing southeast towards an intermittent stream and area of intermittent wetlands. There is no permanent waterbody in the vicinity of the site.

5.3 Nature and Extent of Contamination and Conceptual Site Model

This section presents the results from the Remedial Investigation (RI) and prior investigations which identified the contaminants of concern at the Site.

5.3.1 Soil Contamination

Soil borings were completed prior to the RI which indicated contamination in the soil above EPA RSLs for residential soil. These investigations did not find the horizontal or vertical extent of the soil contamination. During the RI, the horizontal and vertical extent of contamination was identified for aldrin and dieldrin in the soil above the RSL. The vertical extent across much of the site was 3-4 feet bgs with an area around monitoring well FTBRH-MW-01 extending to 11-feet bgs. The total aerial extent is approximately 6,800 square feet with a volume of impact soil estimated to be approximately 1,500 cubic yards (CY).

5.3.2 Groundwater Contamination

During the RI, groundwater was sampled from site monitoring wells and four temporary locations. Two monitoring wells and three temporary wells had detections above the NC2L for Dieldrin of 0.002 µg/L. One monitoring well and three temporary wells had detections above the NC2L for Aldrin of 0.002 µg/L. The groundwater flow direction provided on the maps does not match the calculated groundwater elevation collected during the investigation. Using that data, the groundwater would flow to the southeast. The southeasterly flow is supported by more recent gauging events. The source of that error is unknown.

In 2020, additional sampling was completed for a SRI (USACE, 2020). The results of the groundwater did not find aldrin exceeding the NC2L in any sample and only the sample from FTBRH-MW-01 was above the NC2L. Groundwater flow during this sampling was noted as going to the southeast.

Supplemental sampling was completed in 2023 as documents were found indicating the potential for other contaminants to be present at the Site. This sampling found that Aldrin and Dieldrin was above the NC2L in the filtered groundwater samples.

5.3.3 Conceptual Site Model

The Conceptual Site Model (CSM) was developed during the RI, including the physical setting. The nature and extent of the contamination, and the contaminant fate and transport. The Selected Remedy will address the soil and groundwater at the site.

The primary threat at the site is present in the sub-surface soils. The CSM indicated complete pathways for the subsurface soil for human construction workers, trespassers (or visitors), future residents, and biota. Removing the contaminated soil will remove the pathway for exposure at the site. Treatment of the groundwater will protect future human receptors from exposure to contaminated groundwater by ingestions or dermal contact above unacceptable risk.

A graphical representation of the CSM is in Figure 8.

6.0 Current and Future Potential Land Use and Groundwater Use

Current land use at the Site is as a grassy field. As noted during site visits, residents use the area for recreational purposes. The land use is not expected to change. Adjacent to the site is an office building to the northeast, residential is approximately 400 feet north,

and a historical display of planes is immediately west of the site. Groundwater at the Site is currently not used, and a restriction exists on groundwater wells in the cantonment area. The assumptions for the future usage of the site is based on the area being wholly owned by the Department of Defense.

7.0 Summary of Site Risks

As part of the RI, a baseline HHRA and Ecological Risk Assessment (ERA) were conducted to determine the current and potential future effects of contaminated media on human health and the environment in the absence of any cleanup actions at the Site. These baseline risk assessments (before any cleanup) provide the basis for taking a remedial action and indicate the exposure that pathways need to be addressed by the remedial action. This section summarizes the HHRA and ERA.

Chemicals of potential concern (COPCs) were identified for each exposure area and each medium based on a comparison of maximum detected concentrations from the RI to health-based screening values. These health-based screening values are the RSLs developed by the USEPA and are updated twice yearly (EPA, 2023). The RSLs represent a hazard quotient (HQ) of 1.0 and cancer risk of 10^{-6}. If the maximum detected concentration was greater than the RSL, that chemical was identified as a COPC for that medium for the exposure area and a more detailed site-specific evaluation was completed. The potential for ecological risks from exposure to contaminants detected at the site was assessed through the completion of a Screening Level Ecological Risk Assessment (SLERA).

7.1 Human Health Risk Assessment

The primary chemicals of concern at this site in groundwater and soil are aldrin and dieldrin. The current assumption is that land and groundwater use will remain the same. The land is currently used as a recreational area while the groundwater is not used in this area. Adjacent to the area is additional commercial, industrial, and residential areas typical of a military base. Building 192 is within the bounds of the site and is an unused covered parking stall. Previously, Building 192 used to store and maintain golf carts as well as storage of herbicides and pesticides. A qualitative and quantitative human health risk assessment and screening-level ecological risk assessment was performed as part of the remedial investigation to evaluate and identify the existing or potential adverse effects to human health and the environment by exposure to hazardous substances at the site.

Potential human receptors with a complete exposure pathway that were evaluated included a construction worker, recreational user, and future resident. All analyses were consistent with the current and anticipated future land use. Carcinogenic risk and noncarcinogenic hazard were evaluated for aldrin and dieldrin for potential exposure routes. A carcinogenic risk is one associated with an increased risk of developing cancer and a noncarcinogenic hazard is one where noncancer health effects result from an exposure to the contaminants.

The carcinogenic risk for a future resident is above the target risk range of $1X10^{-6}$. The risk calculated for a future resident (age adjusted Child/Adult) due to exposure to surface soil, shallow soil, subsurface soil, and groundwater combined is $6X10^{-4}$. Risk for a future adult resident is as follows: surficial soils is $1.5X10^{-5}$, shallow soils $8.7X10^{-5}$, $1.5X10^{-5}$ for subsurface soils, and $5.1X10^{-4}$ for groundwater.

Carcinogenic risks for a current/future construction worker for groundwater and surficial soil exposure is $1.06X10^{-4}$ and for a current/future visitor for groundwater and surficial soil exposure is $5.18X10^{-7}$. Only the exposure to a current/future construction worker is above the $1X10^{-6}$ target risk.

For noncarcinogenic risks, a Hazard Index (HI) greater than one (1.0) indicates a potential hazard due to exposure. For combined soil and groundwater, the HI for an adult is 1 and a child is 3. As a result, the noncancer hazards are considered unacceptable for these receptors, which indicates that exposure to the contaminants of concern (COC) at CCFTBR-H does pose a potential concern for adverse noncarcinogenic human health effects.

The risk characterization followed the methodology described in EPA guidance (EPA, 1989, 1997). The EPA methods are appropriately designed to be health-protective and tend to overestimate, rather than underestimate, risk. The risk results are, therefore, conservative.

7.2 Ecological Risk Assessment

The RI included a SLERA to screen for ecological risks at the site. Potential risks were found to mammals and birds due the aldrin and dieldrin in the soil. The SLERA used conservative screening-levels assumptions with 100% site use, 100% bioavailability, and 100% of the diet consists of the most contaminated dietary, and no effect toxicity data to evaluate risk to populations of upper trophic level organisms.

Site conditions were evaluated in the RI which adjusted the home range and exposure areas for receptors to better represent the size of the contaminated area and species present. The result is that the aldrin and dieldrin is unlikely to pose an unacceptable risk to wildlife.

No listed species are known to inhabit the Site. Low effect ecological screening is considered protective of the primary ecological unit of concern. Based on this assessment, the concentrations of dieldrin may have adverse effects on small insectivorous and omnivorous mammals. Based on the limited area affected and the presence of unaffected habitat adjacent to the site, the affected area is considered unlikely to have substantial effects on wildlife populations. No additional baseline assessment of ecological risk was completed.

7.3 Basis for Remedial Action

The HHRA demonstrated the presence of unacceptable risks to human health and that remedial actions are necessary to reduce the risks to within or below the EPA's acceptable risk range. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

8.0 Remedial Action Objectives

Remedial Action Objectives (RAOs) are specific goals to protect human health and the environment. These objectives are based on available information and standards, such as ARARs, to-be-considered (TBC) guidance, and site-specific risk-based levels.

The RAO for CCFTBR-H is to prevent receptor exposure to contaminated soils that exceeds acceptable risk. The cleanup goal for the site is to remove soils above the soil to groundwater EPA Regional Screening Level (RSL) (EPA, 2023) of $1.5X10^{-4}$ mg/kg for aldrin and $7.1X10^{-5}$ mg/kg for dieldrin. The North Carolina Preliminary Soil Remediation Goals (PSRG) (NCDEQ, 2023) has a protection of groundwater level of $6.6X10^{-3}$ mg/kg for aldrin and $1.6X10^{-3}$ mg/kg for dieldrin. Utilization of the EPA RSL for soil removals will meet both state and federal guidance. This will protect potential future human receptors from exposure to contaminated soils through ingestion, dermal contact and inhalation above unacceptable risk.

Groundwater will be treated to obtain the objective of being below the NC2L standard of 0.002 µg/L for aldrin and dieldrin. The removal of the source soils to the water table will remove the source for groundwater contamination. Treatment of the groundwater will protect future human receptors from exposure to contaminated groundwater by ingestion or dermal contact above unacceptable risk.

9.0 Description of Alternatives

The focus of the Proposed Plan is to recommend a remedial alternative to eliminate the unacceptable risk to human health and the environment from soil and groundwater contamination at the CCFTBR-H site. The National Contingency Plan (NCP) has specific statutory requirements for remedial actions that must be addressed in the ROD and supported by the Feasibility Study (FS). These requirements state that remedial actions must:

- Be protective of human health and the environment;
- Attain ARARs (or provide grounds for invoking a waiver);
- Be cost-effective;
- Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- Satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element *or* provide an explanation in the ROD as to why it does not.

In addition, the NCP emphasizes long-term effectiveness and related considerations, including:

- The long-term uncertainties associated with land disposal;
- The goals, objectives, and requirements of the Solid Waste Disposal Act;
- The persistence, toxicity, and mobility of hazardous substances and their constituents, and their propensity to bioaccumulate;
- Short- and long-term potential for adverse health effects from human exposure;
- Long-term maintenance costs;
- The potential for future remediation action costs if the alternative remedial action in question were to fail; and
- The potential threat to human health and the environment associated with excavation, transportation, and re-disposal, or containment.

The nine evaluation criteria listed in the NCP (40 CFR 300.430(e)) encompass statutory requirements and technical, cost, and institutional consideration the program has determined appropriate for thorough evaluation.

Four alternatives were considered in the evaluation of how to best satisfy the nine evaluation criteria in the NCP and achieve the RAOs for this site. The alternatives are:

- Alternative 1 – No Action
- Alternative 2 – Institutional Controls and Groundwater Long-term Groundwater Monitoring (LTM)
- Alternative 3 – Soil Excavation, Offsite Disposal, and Groundwater LTM
- Alternative 4 – Soil Excavation, Offsite Disposal, Groundwater Treatment, and Groundwater Monitoring

9.1 Alternative 1: No Action

Estimated Capital Cost: $0
Estimated Annual O&M Cost: $0
Cumulative Present Value: $0
Estimated Timeframe: N/A

The NCP, 40 CFR, Part 300, requires that the "No Action" alternative be considered as a baseline for comparison with the other alternatives. The No Action alternative involves no additional remedial activities to be conducted at the Site and provides a baseline against which impacts of the various remedial alternatives can be compared. There would be no change to the soil contamination concentrations because no treatment, containment, or removal of soil would occur. Groundwater concentrations would also be unaffected by this alternative as the soil source remains present and no treatment or containment would occur. This alternative does not meet the threshold criteria of protectiveness and compliance with ARARs and therefore will not be considered further.

9.2 Alternative 2: Institutional Controls (ICs) and Groundwater LTM

Estimated Capital Cost: $120,584
Estimated Annual Operation and Maintenance (O&M): $37,935
Cumulative Present Value: $1,141,311
Estimated Timeframe: 30 years

Alternative 2 consists of a restriction to be specified in Fort Liberty's annual Land Use Controls Certification Letter to NCDEQ and the Installation Master Plan. Personnel conducting intrusive activities at the site would require training to avoid exposure to site contaminants. Land use would be limited to industrial or commercial use. Long-term groundwater monitoring would ensure that the groundwater plume does not migrate to the intermittent stream that is adjacent to the site. Additional monitoring wells would need

to be installed to ensure monitoring downgradient of FTBRH-MW-01. The ICs would also prohibit any use of groundwater at the site for potable use. Additional restrictions would be necessary to restrict access to the contaminated surficial soils. Any additional actions, such as fencing, needed to restrict access are not included in this estimate as they would need to be determined by NCDEQ. This option would require ARAR waivers for soil and groundwater being above the preliminary remedial goals (PRGs). Implementation time would be approximately six to nine months to implement the ICs and required access restrictions. Groundwater would be monitored until PRGs are met which is expected to be greater than 30-year project lifetime evaluated.

9.3 Alternative 3: Soil Excavation, Offsite Disposal, and Groundwater LTM

Estimated Capital Cost: $247,609
Estimated Annual Operation and Maintenance (O&M): $13,669
Cumulative Present Value: $626,114
Estimated Timeframe: 30 years

Alternative 3 consists of excavation of all soils exceeding PRGs to a depth of up to 11 ft bgs using conventional earth-moving equipment. Excavated soils would be placed into lined roll-offs for characterization. Soils that were determined to be non-hazardous would be transported by a licensed transport and disposal company to the nearest available RCRA Subtitle D landfill for disposal. Soils that were determined to be characteristically hazardous would be sent to a designated hazardous waste landfill. Soil sampling of the sidewalls and base of the excavation would be performed to determine whether any soil exceeding PRGs remain. If soil exceeding PRGs does remain, the excavation would be expanded, and the confirmation sampling would be repeated. Upon removal of all contaminated soil, the site would be graded, and restored to prevent soil erosion. Groundwater would be monitored until PRGs are met which is expected to be greater than 30-year project lifetime evaluated. An ARAR waiver would be needed for the groundwater portion of this remedy. Implementation time for the soil removal would be approximately 12 months.

The major components of Alternative 3 include the following:

- Placement of silt fencing and other temporary drainage control features.
- Clearing and grubbing of the proposed excavation areas and adjacent staging areas.
- Placement of temporary construction fencing and signs to discourage unauthorized entry.

- Removal of contaminated soil exceeding PRGs up to a depth of 11 ft bgs with a total estimated volume of approximately 1,500 CY.
- Disposal of non-hazardous waste at a RCRA Subtitle D landfill.
- Confirmation sampling of excavation.
- Decontamination of equipment.
- Disposal of decontamination water at a licensed disposal facility.
- Reinstallation of monitoring wells removed during excavation.

9.4 Alternative 4: Soil Excavation, Offsite Disposal, Groundwater Treatment, and Groundwater Monitoring

Estimated Capital Cost: $514,943
Estimated Annual O&M: $23,412
Cumulative Present Value: $752,696
Estimated Timeframe: 10 years

Alternative 4 consists of excavation of all soils exceeding PRGs to a depth sufficient to remove contamination above PRGs or until groundwater is encountered using conventional earth-moving equipment. Excavated soils would be placed into lined roll-offs for characterization. Soils that were determined to be non-hazardous would be transported by a licensed transport and disposal company to the nearest available RCRA Subtitle D landfill for disposal. Soils that were determined to be characteristically hazardous would be sent to a designated hazardous waste landfill. Soil sampling of the sidewalls and base of the excavation would be performed to determine whether any soil exceeding PRGs remain. If soil exceeding PRGs does remain, the excavation would be expanded, and the confirmation sampling would be repeated. Upon removal of all contaminated soil, the site would be graded, and restored to prevent soil erosion.

Replacement monitoring wells would then be installed to replace those removed during excavation activities. Injection of the HRC and micro-scale carbon would then commence to treat the groundwater plume. HRC would work to break down the contaminants of concern and the micro-scale carbon will provide insurance that if any dieldrin back diffuses out of saturated soils, not accessible to be removed during excavation, the contaminant will be immobilized while natural breakdown processes occur.

These injections would take place in the area where groundwater contamination in filtered groundwater samples exceeds the NC2L of 0.002 µg/L. It is estimated that after injections are completed at the site, groundwater concentrations will decrease allowing site closure with no restrictions after the required post-remediation monitoring period. The

groundwater monitoring program will be evaluated at two years to determine if groundwater PRGs are met, or if additional monitoring is needed. All ARARs would be met with this option and would not require a waiver. The time to implement this option is the longest at 16-24 months. Cumulative Present Value is calculated using 10-years post-remedy groundwater monitoring.

The major components of Alternative 4 include the following:

- Placement of silt fencing and other temporary drainage control features.
- Clearing and grubbing of the proposed excavation areas and adjacent staging areas.
- Placement of temporary construction fencing and signs to discourage unauthorized entry.
- Removal of contaminated soil exceeding PRGs up to a depth of 11 ft bgs with a total estimated volume of approximately 1,500 CY.
- Disposal of non-hazardous waste at a RCRA Subtitle D landfill.
- Confirmation sampling of excavation.
- Decontamination of equipment.
- Disposal of decontamination water at a licensed disposal facility.
- Reinstallation of monitoring wells removed during excavation.
- Injection of HRC using a direct push rig.
- Injection of micro-scale carbon using a direct push rig.
- Groundwater sampling post-injection.

9.5 Expected Outcome of the Selected Remedy

The Selected Remedy presented will prevent current and potential future exposure to Aldrin and Dieldrin contaminated soils and groundwater at the Site. Through the use of treatment technology, the Selected Remedy will permanently reduce the toxicity, mobility, and/or volume of contaminants in Site media and remove principal soil contamination to the maximum extent practicable.

10.0 Comparative Analysis of Alternatives

The alternatives discussed above were compared to each other with the nine criteria set forth in 40 CFR § 300.430(e)(9)(iii) of the NCP in order to select a remedy for the Site. The nine criteria are categorized according to three groups; threshold requirements; primary balancing criteria; and modifying criteria. These evaluation criteria relate directly to the requirements of Section 121 of CERCLA, 42 U.S.C § 9621, which determine the feasibility and acceptability of the remedy.

Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs among remedies. State and community acceptance are modifying criteria formally taken into consideration after public comment is received on the Proposed Plan. A summary of each criteria is presented below, followed by a summary of the relative performance of the alternatives with respect to each of the nine criteria. These summaries provide the basis for determining which alternative provides the “best balance” with respect to the nine criteria.

Evaluation Criteria for Remedial Alternatives
Threshold criteria: Must be satisfied in order for a remedy to be eligible for selection.
1.1 **Overall Protection of Human Health and the Environment** determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through ICs, engineering controls, or treatment.
2.1 **Compliance with ARARs** evaluates whether the alternative will meet all applicable or relevant and appropriate requirements (ARARs) of Federal and State environmental statues, regulations, and other requirements that pertain to the site, and/or justifies a waiver
Primary balancing criteria: Used to weigh major tradeoff between remedial alternatives.
3.1 **Long-term Effectiveness and Permanence** considers the expected residual risk and the ability of an alternative to maintain protection of human health and the environment over time.
4.1 **Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment** evaluates the anticipated performance of an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5.1 **Short-term Effectiveness** considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during the construction and implementation period, until the cleanup goals are achieved.
6.1 **Implementability** considers the technical and administrative feasibility of implementing an alternative, including the availability of goods and services needed to implement a particular option.
7.1 **Cost** includes estimated capital and annual operations and maintenance costs; compared as present worth cost.
Modifying Criteria: Considered after public comment is received on the Proposed Plan.
8.1 **State/support Agency Acceptance** addresses whether the State concurs or has comments on the preferred alternative, as described in the Proposed Plan.
9.1 **Community Acceptance** considers whether the local community agrees with the analysis of the preferred alternative, as described in the Proposed Plan.

10.1 Overall Protection of Human Health and the Environment

No action alternatives (Alternative 1) must be evaluated in accordance with CERCLA and the NCP to serve as a basis for comparison with the other alternatives. Alternative 1 is not protective of human health and the environment because it does not address the

unacceptable exposures to contaminated media. Alternative 1 fails to meet the threshold criterion of protectiveness and will not be considered further.

Protection to human health and the environment is addressed to varying degrees by the evaluated alternatives. Alternative 2 implements ICs and groundwater long-term monitoring. As future use is expected to remain as is, ICs would require restrictions on access to the Site to prevent human exposure to contaminated surficial soils. Having access restrictions in place for the Site is not desired by the Army. This alternative also does not mitigate the migration of contamination to groundwater or prevent wildlife access to the contaminated soils. Alternative 3 and 4 removes the soil source which will stop the migration of contamination to groundwater and prevent exposure to contaminated soils to both humans and wildlife. Alternative 4 includes groundwater treatment which will reduce the long-term monitoring needs and has the greatest potential to have lower long-term costs.

10.2 Compliance with ARARs

Any cleanup alternative selected must comply with all federal and state ARARs or provide a basis upon which such requirements can be waived. *Applicable* requirements are those environmental standards, requirements, criteria, or limitations promulgated under federal or state law that are legally applicable to the remedial action to be implemented at the Site. *Relevant and appropriate* requirement, while not being directly applicable, address problems or situations sufficiently similar to those encountered at the Site that their application is well-suited to the particular circumstance. The ARARs are described in Appendix D.

Alternative 2 would require ARAR waivers as dieldrin contaminated surficial and subsurface soils would remain in place. The contaminated soil would serve as an ongoing contributing source of groundwater contamination. An ARAR waiver would also be needed for contaminated groundwater to remain above the NC2L. Alternatives 3 and 4 will attain federal and state ARARs by removing the contaminated soil. Alternative 3 would need an ARAR waiver for contaminated groundwater to remain in place above the NC2L. Alternative 4 will attain federal and state ARARs for groundwater through in-situ treatment with HRC and micro-scale carbon.

10.3 Long Term Effectiveness and Performance

Alternative 4 would most effectively remediate the soil and groundwater at the site to meet remedial goals. Alternative 4 is an effective and permanent option as contaminated soils are removed from the site and groundwater is treated in-situ. Alternative 3 would be less effective as the groundwater would not be treated and would persist due to the

contaminant. Alternative 2 would not address Site contamination but would restrict access to the Site.

10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 would not yield any reduction of contaminants present at the site. Alternative 3 would reduce toxicity, mobility and volume of contaminants at the Site by removal of the contaminated soils; groundwater would have no reduction. Alternative 4 reduces toxicity, mobility, and volume of contaminants by removal of the contaminated soils as well as treatment of the groundwater.

10.5 Short-term Effectiveness

Alternatives 3 and 4 present similar short-term risks to workers and the community. Alternative 4 has slightly more short-term risks to workers due to the addition of groundwater treatment. Alternative 3 and 4 have identical times for the commencement of work but Alternative 4 will take slightly longer (16-24 months) to finish due to the groundwater treatment.

Human health hazards will be mitigated during implementation through air monitoring, security fencing around the construction area, and signage denoting the construction area. Alternative 4 would require the shipment of HRC and micro-scale carbon to the site, be moved onsite, and stored onsite during implementation of the injections. Short-term risks associated with Alternatives 3 and 4 would be addressed through health and safety procedures and engineering controls.

10.6 Implementability

Both Alternative 3 and 4 are readily implementable using standard construction equipment since they both require the same excavation. Disposal of the contaminated soils requires logistics but is easily implemented. Alternative 4 would require the use of a direct push rig to deliver injectants to the groundwater which is readily available. Daylighting of the injectants is not expected due to the site geology.

10.7 Cost

The estimated present worth costs for the alternatives, not including the No Action alternative, range from $1,141,311 for Alternative 2 to $752,696 for Alternative 4. The cost of each alternative increases with the degree of cleanup at the site. Cost summaries can be found in Appendix C.

10.8 State Acceptance

NCDEQ had no additional comments or recommendations for the Proposed Plan in a letter dated November 18, 2022.

10.9 Community Acceptance

During the public comment period, no responses were received. The Army published a notice in the *Fayetteville Observer* on December 16th. The Army held a 30-day public comment period from December 16, 2022 to January 18, 2023, to accept public comments on the remedial alternative presented in the Proposed Plan, as well as other documents contained in the Administrative Record File.

11.0 Principal Threat Waste

The NCP, 40 C.F.R §300.430(a)(1)(iii)(A), establishes an expectation that treatment will be used to address the principal threats posed by a site wherever practicable. The "principal threat" concept is applied to the characterization of "source materials" at a CERCLA site. A source material is material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination, for example, to groundwater. Principal threat wastes are those source materials considered to be highly toxic or highly mobile, which would present a significant risk to human health or the environment should exposure occur.

The concentrations of Dieldrin is considered to be principal threat waste at the Site. The concentrations in the soil acts as a reservoir for continued groundwater contamination. Treatment of the principal threat waste to the maximum extent practicable is a component of this ROD. By addressing the soil contamination, a major source of the groundwater contamination will be eliminated. A remedy for the groundwater is also addressed in this ROD.

12.0 Selected Remedy

Following review and consideration of the information in the Administrative Record, the requirements of CERCLA and the NCP, and public comments, the Army has selected the following alternative as the Selected Remedy for the Site:

Alternative 4: Soil Excavation, Offsite Disposal, Groundwater Treatment, and Groundwater Monitoring

12.1 Summary of the Rationale for Selected Remedy

The Army's Selected Remedy meets the threshold criteria for overall protection of human health and the environment and compliance with ARARs. Based on the information currently available, the Army has determined that the Selected Remedy provides the best

balance of advantages and disadvantages among the alternatives when evaluating them using the balancing criteria. The Army's Selected Remedy for the Site satisfies the following statutory requirements of Section 121 of CERCLA, 42 U.S.C §9621:

1) Be protective of human health and the environment;
2) Comply with ARARs (or justify a waiver);
3) Be cost-effective;
4) Provide short- and long-term reduction of risk;
5) Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
6) Satisfy the preference for treatment as a principal element.

The Selected Remedy will meet the following RAOs:

- Prevent exposure via incidental ingestion, dermal contact, or inhalation of surficial and subsurface soils contaminated with Dieldrin that pose an unacceptable cancer risk greater than $1X10^{-6}$ and non-cancer risk greater than 1;
- Prevent continued migration of contaminants in the soil to the underlying groundwater that would result in groundwater contamination above the NC2L;
- Removal of the principal threat waste in the source area, to the maximum extent practicable, to minimize the continuing source of contamination to groundwater; and
- Treatment of groundwater to meet the NC2L.

The Selected Remedy is readily implementable. It will address principal threat waste and eliminate a source to groundwater contamination.

12.2 Description of the Selected Remedy

Based on the comparison of the nine criteria, the Army's Selected Remedy for the Site is *Alternative 4 - Soil Excavation, Offsite Disposal, Groundwater Treatment, and Groundwater Monitoring*. The Army has determined that the Selected Remedy for the Site will be the most effective in addressing contaminated groundwater and soil.

Remedy Components of Alternative 4

Contaminated surficial and sub-surface soils will be excavated and disposed of in an appropriate landfill. Once all contaminated materials are excavated, clean fill will be placed into the excavation. Upon completion of backfilling the excavation, injections of HRC and micro-scale carbon into the groundwater will take place. This treatment will address the dieldrin contaminated groundwater. The only IC expected to be in place is the existing prohibition on groundwater wells (drinking or non-potable uses) in the cantonment of Fort Liberty.

O&M Components of Alternative 4

O&M of this remedy would be limited to a period immediately following excavation to ensure no erosion takes place while vegetation is re-established. Continuing O&M will consist of annual groundwater monitoring until concentrations are below the NC2L.

Design Considerations of Alternative 4

In order to excavate soils for the Site, silt fencing will need to be erected to reduce runoff of soils during rain events. During excavation, confirmation samples will be collected to ensure that Dieldrin contaminated soils have been removed to the maximum extent practicable. Based on investigations to date, it is not anticipated that soils will exhibit a characteristic of hazardous water. There are no RCRA listed hazardous wastes or principal threat wastes known to be present in the soil. If unexpected conditions are found during excavation (ex. pipes or other non-soil-like debris), waste may be disposed of offsite in a Subtitle C or D landfill based on the material encountered. If materials like drums or septic tanks are encountered, excavation will stop to reassess site conditions, the selected remedy, and determine appropriate disposal options based upon waste characterization. Upon completion of the excavation, the area will be backfilled with clean material (suitable for residential use) and revegetated with grass mix which matches current site conditions.

It is assumed that the in-situ treatment of groundwater will involve an HRC and micro-scale carbon product.

12.3 Cost Estimate for the Selected Remedy

The estimated cumulative present value for the Selected Remedy is $752,696. Appendix C includes details of the estimated costs to implement the Selected Remedy. The information in this cost estimate is based upon the best available information regarding the anticipated scope to the Remedial Action.

Changes to the cost estimates may occur during implementation as a result of new information and data collected during the engineering design of the Selected Remedy. Major changes to the Selected Remedy may be documented in the form of a memorandum to the Administrative Record File, an Explanation of Significant Differences (ESD), or a ROD Amendment, as appropriate. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.4 Expected Outcome of the Selected Remedy

Implementation of the Selected Remedy at the Site is expected to eliminate the principal threat waste and reduce groundwater contamination to below the NC2L. The Selected Remedy will reduce the potential for contaminants in the soil to migrate to groundwater at concentrations exceeding the NC2L groundwater standard. The groundwater treatment at the Site is expected to reduce groundwater monitoring from 30 years to less than 5

years. Cost of the remedy does include a full 30 years of monitoring. Currently the site is utilized as more of a recreational area by residents in the area and the usage is expected to remain the same in the future. The Selected Remedy does open up the possibility for utilizing the site for other uses including residential uses.

13.0 Statutory Determinations

Under Section 121 of CERCLA, 42 U.S.C. §9621 and 40 C.F.R. §300.430(f)(5)(ii) of the NCP, the Army must select remedies that are protective of human health and the environment, comply with ARARs, are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery to the maximum extent possible. There is also a preference for remedies that use treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a principal element. The following sections discuss how the remedy meets the statutory requirements.

13.1 Protection of Human Health and the Environment

Based on the information currently available, the Army has determined that the Selected Remedy for the Site is protective of human health and the environment as it would achieve RAOs in a relatively quick timeframe. The Selected Remedy would protect underlying groundwater by removing the source material and prevent migration of contamination from soil to groundwater. Additionally, the groundwater will be treated to assist in reaching the NC2L groundwater value.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP, 40 C.F.R §§300.430(f)(5)(ii)(B) and (C), requires that a ROD describe Federal and State ARARs that the remedial action will attain or provide a justification for any waivers. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated, under federal environmental or state environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situation sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

The Selected Remedy will comply with all ARARS listed in Appendix D.

13.3 Cost Effectiveness

The Selected Remedy is cost-effective in providing overall protection of human health and the environment by limiting the risk posed by Site COCs and meeting all other requirements of CERCLA and the NCP at a cost that is proportional to the other alternatives that were evaluated. Further, the Selected Remedy is readily implementable and provides a high degree of both short- and long-term effectiveness. The estimated cumulative present value of the Selected Remedy is $752,696.

13.4 Utilization of Permanent Solutions to the Maximum Extent Practicable

The Selected Remedy represents the maximum extent to which permanent solutions and treatment are practicable at the Site through the excavation of contaminated soils, disposal of contaminated soils, backfilling, and groundwater treatment. The Army has determined that the Selected Remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and costs while also considering the statutory preference for treatment as a principal element and state and community acceptance.

The Selected Remedy will meet the statutory preference for treatment as a principal element by addressing groundwater contamination through in-situ HRC treatment and micro-scale carbon injections.

13.5 Five-Year Review Requirements

The Selected Remedy is expected to bring levels of contamination to allow unlimited and unrestricted exposure within 10 years. Until levels meet that level, a statutory review will be conducted no less often than every five years to ensure that the Selected Remedy is, or will be, protective of human health and the environment pursuant to Section 121(c) of CERCLA, 42 U.S.C §9621(c), and 40 C.F.R §300.430(f)(4)(ii) of the NCP. The first Five-Year Review (FYR) will be completed five-years after the start of on-site construction, subsequent FYRs will be conducted every five years thereafter. FYRs will continue until hazardous substances are no longer present above levels that allow for unlimited use and unrestricted exposure.

14.0 Documentation of Significant Changes

The Proposed Plan was released for public comment on December 16, 2022. No comments were submitted during the comment period. No significant changes to the remedy, as originally identified in the Proposed Plan, are necessary.

15.0 State Role

NCDEQ, on behalf of the State of North Carolina, has reviewed the remedial alternatives presented in the ROD and has indicated its concurrence with the Selected Remedy.

NCDEQ has also reviewed the list of ARARs to determine if the Selected Remedy is in compliance with appropriate State environmental laws and regulations.

16.0 References

A.T. Kearney, Inc. and DPRA, Inc., 1988. *Interim RCRA Facility Assessment Report at Fort Bragg Military Reservation*. July 1988.

Bay West, 2016. *Remedial Investigation/Feasibility Study, Pope AAF Golf Course Pesticide Site, CCFTBR-H, Fort Bragg, North Carolina,* September 2016.

NCDEQ, 2022. *15A NCAC 02L .0202 (NC2L) Groundwater Standards Table*, April 2022.

NCDEQ, 2023. *Inactive Hazardous Sites Branch Preliminary Soil Remediation Goals (PSRG)Table* (Updated First & Third Quarter of Calendar Year) January 2023.

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United States Army Corps of Engineers (USACE), 2018. *Delineation of Groundwater, Pope Golf Course Pesticide Site, Pope Army Airfield, Fort Bragg, North Carolina*, June 2018.

United States Army Corps of Engineers (USACE), 2020, *Supplemental Remedial Investigation Report*, Site CCFTBR-H, Fort Bragg, North Carolina, May 2020.

United States Environmental Protection Agency (USEPA), 2023, *Regional Screening Levels (RSLs) – Generic Tables* (TR=1E-06 THQ=1.0), https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables, Accessed July 3, 2023.

United States Geological Survey, 2023. USGS online geology mapping tool, geology of the State of North Carolina. Accessed 3 July 2023. http://mrdata.usgs.gov/geology/state/map.html?x=-79.390399965657&y=35.5453449609186&z=7#

III. RESPONSIVENESS SUMMARY
CCFTBR-H
FORT LIBERTY, CUMBERLAND COUNTY, NORTH CAROLINA

Introduction

This Responsiveness Summary summarizes the significant comments and concerns received during the public comment period for the Proposed Plan for CCFTBR-H (Site) and provides the Army's responses to those comments. No comments were received during the public comment period and the Army's Selected Remedial Action is the following:

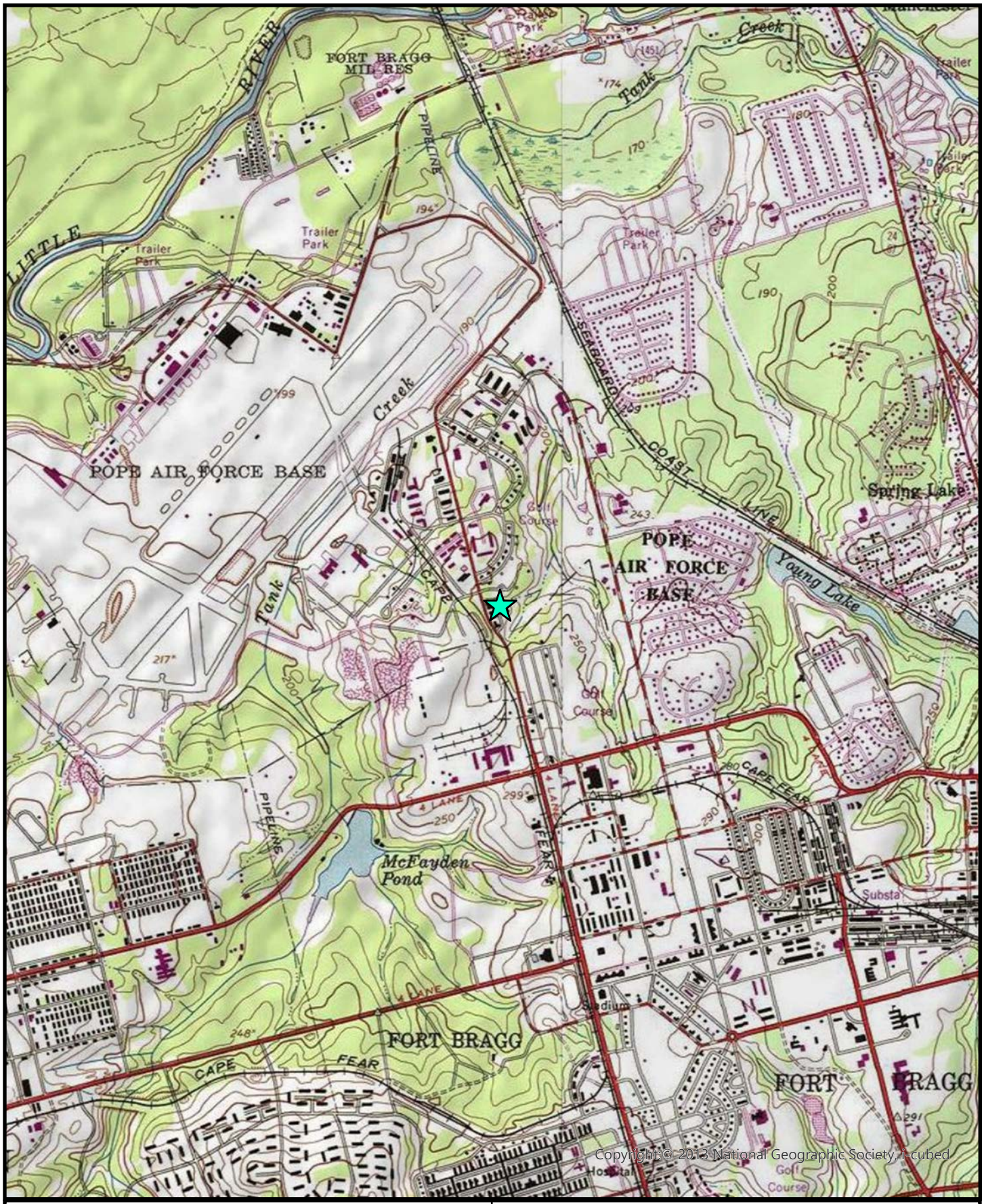
Alternative 4 - Soil Excavation, Offsite Disposal, Groundwater Treatment, and Groundwater Monitoring

The Proposed Plan and supporting documents were made available to the public in the Administrative Record File, which was compiled to support selection of this Remedial Action. The Army provided notice to the public that the Administrative Record Filed could be viewed at the following location:

Cumberland County Public Library
300 Maiden Lane
Fayetteville, North Carolina 28301

The notice of Availability of these documents was published in the *Fayetteville Observer*, a local newspaper, on December 16, 2022. A 30-day public comment period was run from December 16, 2022 through January 23, 2023. Extra days were provided to the comment period due to holidays during the comment period. During this time, the public was able to submit comments in writing, by voicemail, or through email for the Proposed Plan or any other documents within the Administrative Record. No comments were received during the comment period.

FIGURES



CCFTBR-H

0 1,000 2,000 4,000 Feet

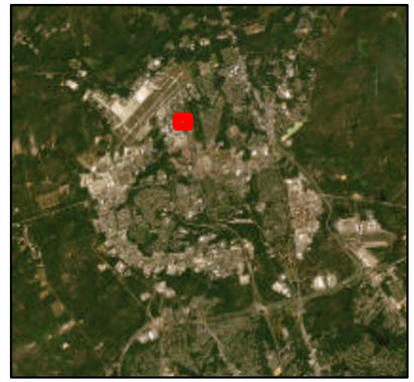
1 inch equals 2,000 feet

N

Site Vicinity Map
CCFTBR-H

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
SAVANNAH, GEORGIA

Figure 1



- Monitoring Well
- Stream
- Wetland
- Building

Building 193 is no longer present. Only included for historical purposes. The building was used as the Pope Willow Lakes Golf Course Pro Shop.

N

0 50 100 200 Feet

1 inch equals 100 feet

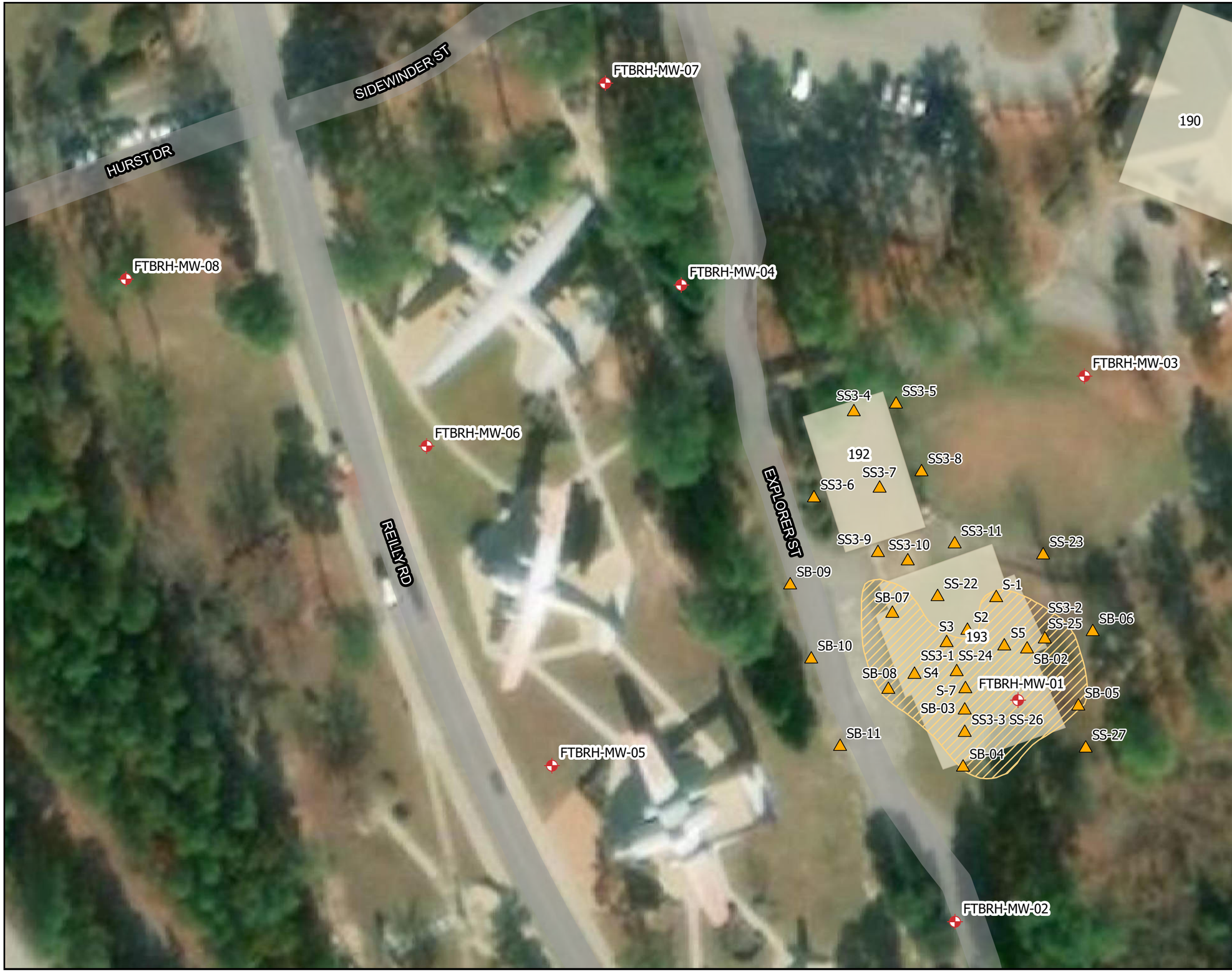
U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT
Geology, Hydrogeology, and HTRW Design Section

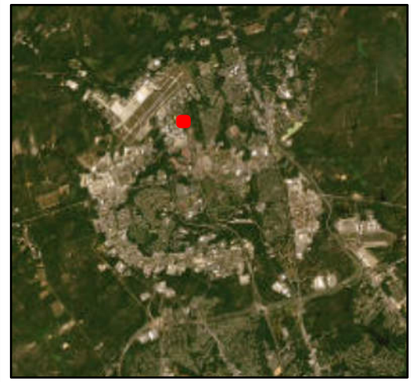
Site Layout

CCFTBR-H

Fort Liberty, North Carolina

July 2023	Figure 2





Monitoring Well
Soil Boring Location
Soil Contamination Extent
Building

N

0 25 50 100 Feet

1 inch equals 50 feet

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT
Geology, Hydrogeology, and HTRW Design Section

Monitoring Wells, Soil Boring Locations, and Soil Contamination Extent

CCFTBR-H

Fort Liberty, North Carolina

July 2023	Figure 3

A

A'

Elevation (ft)

Distance Along Baseline (feet)

SB-11

SB-11		
Depth	Aldrin	Dieldrin
0.5'	<0.64	<0.77

SB-11		
Depth	Aldrin	Dieldrin
3.0'	<0.51	<0.61

SB-11		
Depth	Aldrin	Dieldrin
6.0'	<0.6	<0.72

SB-08

SB-08		
Depth	Aldrin	Dieldrin
0.5'	1.5	37.4

SB-08		
Depth	Aldrin	Dieldrin
3.0'	<0.53	<0.64

SB-08		
Depth	Aldrin	Dieldrin
6.0'	<0.53	<0.63

SB-03

SB-03		
Depth	Aldrin	Dieldrin
0.5'	112	812

SB-03		
Depth	Aldrin	Dieldrin
3.0'	135	834

SB-03		
Depth	Aldrin	Dieldrin
6.0'	72.2	578

SB-03		
Depth	Aldrin	Dieldrin
10.0'	<0.58	3.4

SB-03		
Depth	Aldrin	Dieldrin
11.5'	<0.58	<0.77

SB-01/FTBRH-MW-01

SB-01		
Depth	Aldrin	Dieldrin
0.5'	77.4	769

SB-01		
Depth	Aldrin	Dieldrin
3.0'	584	2290

SB-01		
Depth	Aldrin	Dieldrin
6.0'	<0.54	6

SB-02

SB-02		
Depth	Aldrin	Dieldrin
0.5'	<0.54	87.9

SB-02		
Depth	Aldrin	Dieldrin
3.0'	<0.52	11.7

SB-02		
Depth	Aldrin	Dieldrin
6.0'	<0.58	3.4

SS3-2/SS-25

SS-25		
Depth	Aldrin	Dieldrin
0.5'	1.7	520

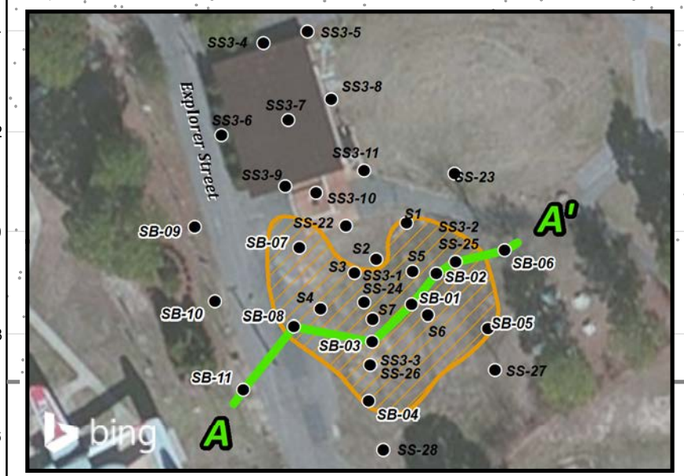
SS3-2		
Depth	Aldrin	Dieldrin
2'	470	2600

SB-06

SB-06		
Depth	Aldrin	Dieldrin
0.5'	<0.52	2

SB-06		
Depth	Aldrin	Dieldrin
3.0'	<0.58	<0.70

SB-06		
Depth	Aldrin	Dieldrin
6.0'	<0.53	14.7



Sand

Inferred Extent of Aldrin/Dieldrin Contamination in Soil

Well Screen

Groundwater Elevation at Well (02/29/2016)

Estimated Water Table Elevation (2/29/2016)

SAMPLE ID		
Depth	Aldrin	Dieldrin
Feet	µg/kg	µg/kg

NOTES:

1) All results shown in µg/kg (Micrograms per kilogram)
2) Results with yellow shading exceed the USEPA Residential Screening Levels (Nov 2015)

VERTICAL SCALE (FEET) 4

HORIZONTAL SCALE (FEET) 20

ENGR'G	D.K.	DATE	Bay West
DRAWN	S.G.	8/23/2016	Customer-Focused Environmental & Industrial Solutions
REV.	00		
PROJECT NAME	POPE GOLF COURSE PESTICIDE SITE		
TITLE	Cross Section A to A'		
		FIGURE #	4

Y:\Clients\US_ARMY_ENVIRONMENTAL_COMMAND\Fort_Bragg\MapDocs\Pope Golf Course Pesticide Site\J140090 FIG 4-1 Cross Section A to A.mxd

B

B'

SB-01/FTBRH-MW-01

SB-04

SB-03

S2

SS-22

SS3-10

SS3-7

SS3-4

SS-28

SS3-3

FTBRH-MW-02

FTBRH-MW-04

SS-28		
Depth	Aldrin	Dieldrin
0-1	15	15

SS-2		
Depth	Aldrin	Dieldrin
0-1	<33	22

SS-22		
Depth	Aldrin	Dieldrin
0-1	4.5	26

SS3-10		
Depth	Aldrin	Dieldrin
0-0.5'	0.49	0.31

SS3-10		
Depth	Aldrin	Dieldrin
0.5-2'	0.99	0.98

SS3-7		
Depth	Aldrin	Dieldrin
0-0.5'	19	3

SS3-7		
Depth	Aldrin	Dieldrin
0.5-2'	0.5	0.31

SS3-4		
Depth	Aldrin	Dieldrin
0-0.5'	0.49	0.3

SS3-4		
Depth	Aldrin	Dieldrin
0.5-2'	0.5	0.31

SB-04		
Depth	Aldrin	Dieldrin
0-0.5'	<0.55	4.5

SB-04		
Depth	Aldrin	Dieldrin
0.5-3'	<5.6	83

SB-04		
Depth	Aldrin	Dieldrin
3-6'	<0.53	<0.64

SS3-3		
Depth	Aldrin	Dieldrin
0-2'	16	578

MW-01		
Depth	Aldrin	Dieldrin
0-0.5'	77.4	769

MW-01		
Depth	Aldrin	Dieldrin
0.5-3'	584	2,290

MW-01		
Depth	Aldrin	Dieldrin
3-6'	<0.54	6

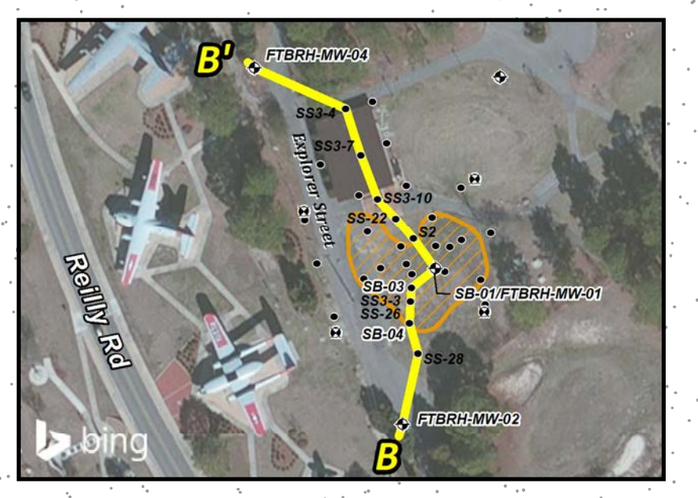
SB-03		
Depth	Aldrin	Dieldrin
0-0.5'	112	812

SB-03		
Depth	Aldrin	Dieldrin
0.5-3'	135	834

SB-03		
Depth	Aldrin	Dieldrin
3-6'	72.2	578

SB-03		
Depth	Aldrin	Dieldrin
9-10'	<0.58	3.4

SB-03		
Depth	Aldrin	Dieldrin
11-11.5'	<0.58	0.77



Elevation (ft)

Distance Along Baseline (feet)

Sand

Inferred Extent of Aldrin/Dieldrin Contamination in Soil

Well Screen

Groundwater Elevation at Well (02/29/2016)

Estimated Water Table Elevation (2/29/2016)

SAMPLE ID		
Depth	Aldrin	Dieldrin
Feet	µg/kg	µg/kg

NOTES:

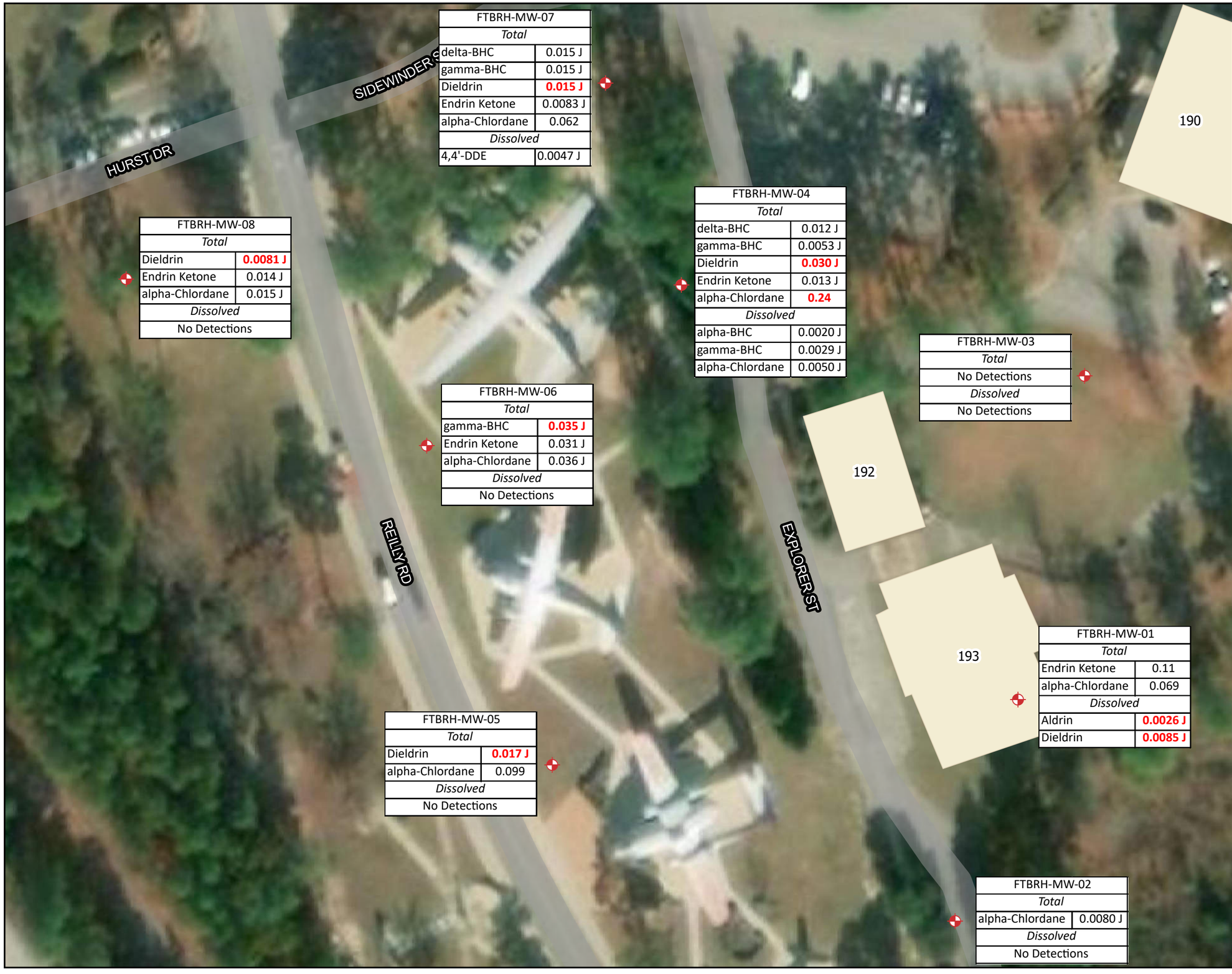
1) All results shown in µg/kg (Micrograms per kilogram)
2) Results with yellow shading exceed the USEPA Residential Screening Levels (Nov 2015)
3) Results with pink shading exceed the USEPA Ecological Soil Screening Level

VERTICAL SCALE (FEET) 4

HORIZONTAL SCALE (FEET) 20

ENGR'G	D.K.	DATE	Bay West
DRAWN	S.G.	8/26/2016	Customer-Focused Environmental & Industrial Solutions
REV.	00		
PROJECT NAME	POPE GOLF COURSE PESTICIDE SITE		
TITLE	Cross Section B to B'		
J140090		FIGURE #	5

Y:\Clients\US_ARMY_ENVIRONMENTAL_COMMAND\Fort_Bragg\MapDocs\Pope Golf Course Pesticide Site\J140090 FIG 4-2 Cross Section B to B.mxd



FTBRH-MW-07	
Total	
delta-BHC	0.015 J
gamma-BHC	0.015 J
Dieldrin	**0.015 J**
Endrin Ketone	0.0083 J
alpha-Chlordane	0.062
Dissolved	
4,4'-DDE	0.0047 J

FTBRH-MW-08	
Total	
Dieldrin	**0.0081 J**
Endrin Ketone	0.014 J
alpha-Chlordane	0.015 J
Dissolved	
No Detections	

FTBRH-MW-04	
Total	
delta-BHC	0.012 J
gamma-BHC	0.0053 J
Dieldrin	**0.030 J**
Endrin Ketone	0.013 J
alpha-Chlordane	**0.24**
Dissolved	
alpha-BHC	0.0020 J
gamma-BHC	0.0029 J
alpha-Chlordane	0.0050 J

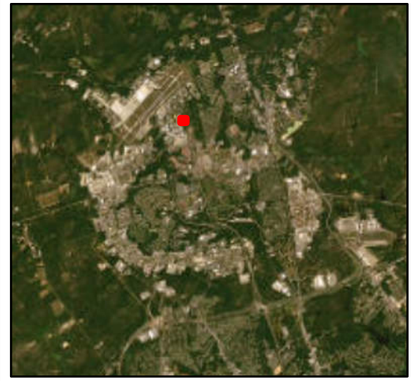
FTBRH-MW-06	
Total	
gamma-BHC	**0.035 J**
Endrin Ketone	0.031 J
alpha-Chlordane	0.036 J
Dissolved	
No Detections	

FTBRH-MW-03
Total
No Detections
Dissolved
No Detections

FTBRH-MW-01	
Total	
Endrin Ketone	0.11
alpha-Chlordane	0.069
Dissolved	
Aldrin	**0.0026 J**
Dieldrin	**0.0085 J**

FTBRH-MW-05	
Total	
Dieldrin	**0.017 J**
alpha-Chlordane	0.099
Dissolved	
No Detections	

FTBRH-MW-02	
Total	
alpha-Chlordane	0.0080 J
Dissolved	
No Detections	



Monitoring Well
Groundwater Contamination Extent (Inferred)
Building

- All Concentrations in micrograms per liter (µg/L)
- J: Estimated Concentration

N

0 25 50 100 Feet

1 inch equals 50 feet

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT
Geology, Hydrogeology, and HTRW Design Section

February 2023 Groundwater Concentrations CCFTBR-H

Fort Liberty, North Carolina

July 2023 | Figure 6

Monitoring Well
Groundwater Contours
Stream
Wetland
Building

N

0 50 100 200 Feet

1 inch equals 100 feet

U.S. ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT
Geology, Hydrogeology, and HTRW Design Section

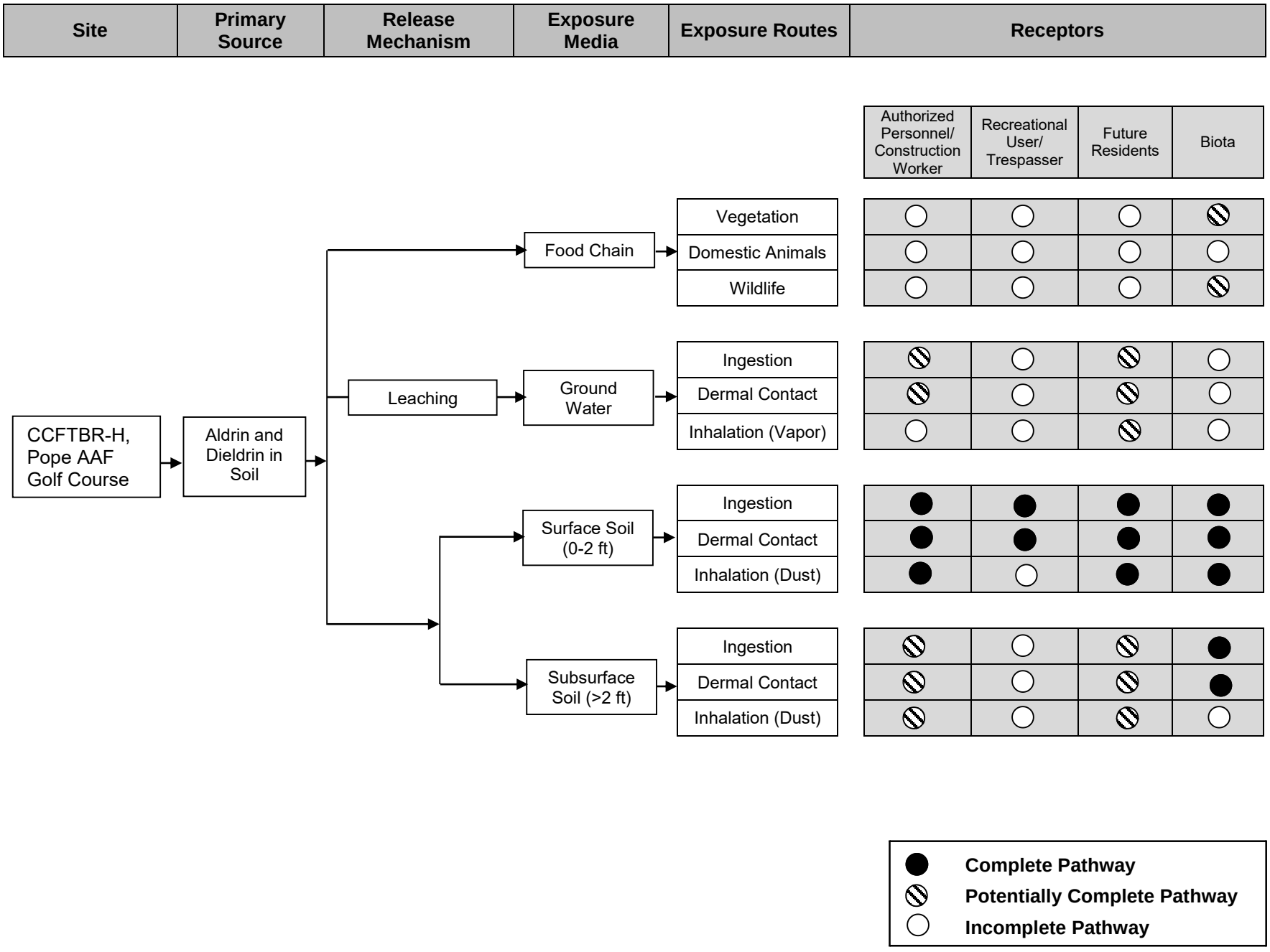
February 2023 Groundwater Elevations

CCFTBR-H

Fort Liberty, North Carolina

July 2023	Figure 7

Figure 8
Conceptual Site Model
CCFTBR-H, Pope AAF Golf Course Pesticide Site



TABLES

Table 1
Historicial Groundwater Concentrations
CCFTBR-H

Client ID:	NC2L GWQS	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-01	FTBRH-MW-02	FTBRH-MW-02	FTBRH-MW-02	FTBRH-MW-02
Matrix:		GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Sampled Date:		11/20/2015	2/29/2016	2/29/2016	12/12/2018	2/4/2020	5/10/2023	5/10/2023	2/29/2016	2/29/2016	12/12/2018	2/4/2020
Filtered		UNK	No	Yes	UNK	No	No	Yes	No	Yes	UNK	No
Pesticides (GC) by Method 8081B (µg/l)												
Aldrin	0.002	ND	ND (0.021)	ND (0.023)	ND (0.0070)	ND (0.0250)	ND (0.0041)	**0.0026 J**	ND (0.020)	ND (0.021)	ND (0.0070)	ND (0.0250)
alpha-Chlordane	0.1	NA	NA	NA	NA	NA	**0.069**	ND (0.016)	NA	NA	NA	NA
Chlordane	0.1	NA	NA	NA	**2.2**	NA	ND (0.41)		NA	NA	**0.20**	NA
Dieldrin	0.002	**0.084**	**0.78**	**0.35**	**1.3**	**0.161**	ND (0.0041)	**0.0085 J**	ND (0.010)	ND (0.010)	ND (0.0037)	ND (0.0250)

Client ID:	NC2L GWQS	FTBRH-MW-02	FTBRH-MW-02	FTBRH-MW-03	FTBRH-MW-03	FTBRH-MW-03	FTBRH-MW-03	FTBRH-MW-03	FTBRH-MW-03	FTBRH-MW-04	FTBRH-MW-04	FTBRH-MW-04
Matrix:		GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Sampled Date:		5/11/2023	5/11/2023	2/29/2016	2/29/2016	12/12/2018	2/4/2020	5/10/2023	5/10/2023	2/29/2016	2/29/2016	12/12/2018
Filtered		No	Yes	No	Yes	UNK	No	No	Yes	No	Yes	UNK
Pesticides (GC) by Method 8081B (µg/l)												
Aldrin	0.002	ND (0.0033)	ND (0.0031)	ND (0.021)	ND (0.020)	ND (0.0070)	ND (0.0250)	ND (0.0038)	ND (0.0041)	**0.095 J**	**0.16 J**	ND (0.0070)
alpha-Chlordane	0.1	**0.0080 J**	ND (0.012)	NA	NA	NA	NA	ND (0.015)	ND (0.017)	NA	NA	NA
Chlordane (Technical)	0.1	ND (0.33)	ND (0.31)	NA	NA	**0.12 J**	NA	ND (0.38)	ND (0.41)	NA	NA	**5.0**
Dieldrin	0.002	ND (0.0033)	ND (0.0031)	ND (0.010)	ND (0.010)	ND (0.0037)	ND (0.0250)	ND (0.0038)	ND (0.0041)	**0.21**	ND (0.010)	**0.088**

Client ID:	NC2L GWQS	FTBRH-MW-04	FTBRH-MW-04	FTBRH-MW-04	FTBRH-MW-05	FTBRH-MW-05	FTBRH-MW-05	FTBRH-MW-05	FTBRH-MW-06	FTBRH-MW-06	FTBRH-MW-06	FTBRH-MW-06
Matrix:		GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
Sampled Date:		2/4/2020	5/10/2023	5/10/2023	12/12/2018	2/4/2020	5/11/2023	5/11/2023	12/12/2018	2/4/2020	5/11/2023	5/11/2023
Filtered		No	No	Yes	UNK	No	No	Yes	UNK	No	No	No
Pesticides (GC) by Method 8081B (µg/l)												
Aldrin	0.002	ND (0.0250)	ND (0.0039)	ND (0.0039)	ND (0.0070)	ND (0.0253)	ND (0.0031)	ND (0.0034)	ND (0.0070)	ND (0.0253)	ND (0.0033)	ND (0.0034)
alpha-Chlordane	0.1	NA	**0.24**	**0.0050 J**	NA	NA	**0.099**	ND (0.013)	NA	NA	**0.036 J**	ND (0.013)
Chlordane (Technical)	0.1	NA	ND (0.39)	ND (0.39)	**0.44 J**	NA	ND (0.31)	ND (0.34)	**2.0**	NA	ND (0.33)	ND (0.34)
Dieldrin	0.002	ND (0.0250)	**0.030 J**	ND (0.0039)	ND (0.0037)	ND (0.0253)	ND (0.0031)	ND (0.0034)	**0.063**	ND (0.0253)	ND (0.0033)	ND (0.0034)

Client ID:	NC2L GWQS	FTBRH-MW-07	FTBRH-MW-07	FTBRH-MW-07	FTBRH-MW-07	FTBRH-MW-08	FTBRH-MW-08	FTBRH-MW-08	FTBRH-MW-08	FTBRH-MW-08
Matrix:		GW	GW	GW	GW	GW	GW	GW	GW	GW
Sampled Date:		12/12/2018	2/4/2020	5/10/2023	5/10/2023	2/4/2020	5/11/2023	5/11/2023	5/11/2023	5/11/2023
Filtered		UNK	No	No	Yes	No	No	Yes	No	Yes
Pesticides (GC) by Method 8081B (µg/l)										
Aldrin	0.002	ND (0.0070)	ND (0.0250)	ND (0.0035)	ND (0.0040)	ND (0.0250)	ND (0.0031)	ND (0.0033)	ND (0.0031)	ND (0.0033)
alpha-Chlordane	0.1	NA	NA	**0.062**	ND (0.016)	NA	**0.015 J**	ND (0.013)	**0.015 J**	ND (0.013)
Chlordane (Technical)	0.1	**0.86**	NA	ND (0.35)	ND (0.40)	NA	ND (0.31)	ND (0.33)	ND (0.31)	ND (0.33)
Dieldrin	0.002	**0.034 J**	ND (0.0250)	**0.015 J**	ND (0.0040)	ND (0.0250)	**0.0081 J**	ND (0.0033)	**0.0081 J**	ND (0.0033)

ND: Not Detected
NA: Not Analyzed
µg/L: microgram per liter
J: estimated concentration

Table 2
Historical Groundwater Elevations
CCFTBR-H

Monitoring Well	Screen Interval (ft bgs)	Well Depth (ft btoc)	TOC Elevation (ft amsl)	Date Measured	Depth to Water (ft btoc)	Water Elevation (ft msl)
FTBRH-MW01	13.0-23.0	23	237.05	2/4/2020	10.58	226.47
				5/11/2023	10.45	226.60
FTBRH-MW02	10.0-20.0	20	235.55	2/4/2020	7.31	228.24
				5/11/2023	7.13	228.42
FTBRH-MW03	10.0-20.0	20	234.15	2/4/2020	6.20	227.95
				5/10/2023	6.01	228.14
FTBRH-MW04	15.0-25.0	25	235.98	2/4/2020	7.18	228.80
				5/10/2023	7.04	228.94
FTBRH-MW05	20.2-30.2	30.2	NA	2/4/2020	12.17	NA
				5/11/2023	12.21	
FTBRH-MW06	18.55-28.55	28.55	NA	2/4/2020	9.62	NA
				5/11/2023	9.52	
FTBRH-MW07	16.35-26.35	26.35	NA	2/4/2020	9.31	NA
				5/10/2023	9.10	
FTBRH-MW08	15.0-25.0	25	249.64	2/4/2020	11.32	238.32
				5/11/2023	11.05	238.59

Table 3
CCFTBR-H
Soil Analytical Results

USACE Sampling - February 2012																
Client Sample ID:	**USEPA Residential Screen Levels (November 2015)**	**USEPA Ecological Soil Screening Level**	**SS-01**		**SS-02**		**SS-03**		**SS-04**		**SS-05**		**SS-06**	
Lab Sample ID:			**680-77458-8**		**680-77458-9**		**680-77458-20**		**680-77458-6**		**680-77458-5**		**680-77458-21**	
Date Sampled:			**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**	
Matrix:			**Soil**		**Soil**		**Soil**		**Soil**		**Soil**		**Soil**	
Aldrin	39	22	0.59	U	0.68	U	0.53	U	0.52	U	0.52	U	0.48	U
Dieldrin	34	22	0.37	U	0.42	U	0.33	U	0.32	U	0.32	U	0.3	U

Client Sample ID:	**USEPA Residential Screen Levels (November 2015)**	**USEPA Ecological Soil Screening Level**	**SS-07**		**SS-08**		**SS-09**		**SS-10**		**SS-11**		**SS-12**	
Lab Sample ID:			**680-77458-19**		**680-77458-18**		**680-77458-3**		**680-77458-4**		**680-77458-1**		**680-77458-2**	
Date Sampled:			**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**	
Matrix:			**Soil**		**Soil**		**Soil**		**Soil**		**Soil**		**Soil**	
Aldrin	39	22	0.6	U	0.51	U	0.47	U	0.52	U	0.52	U	0.50	U
Dieldrin	34	22	0.37	U	0.32	U	0.31	U	0.30	U	**1.8**	**J**	0.49	U

Client Sample ID:	**USEPA Residential Screen Levels (November 2015)**	**USEPA Ecological Soil Screening Level**	**SS-13**		**SS-14**		**SS-15**		**SS-16**		**SS-17**		**SS-18**	
Lab Sample ID:			**680-77458-22**		**680-77458-23**		**680-77458-10**		**680-77458-11**		**680-77458-12**		**680-77458-14**	
Date Sampled:			**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**	
Matrix:			**Soil**		**Soil**		**Soil**		**Soil**		**Soil**		**Soil**	
Aldrin	39	22	0.5	U	0.55	U	0.48	U	0.51	U	0.50	U	0.5	U
Dieldrin	34	22	**0.84**	**J**	0.34	U	0.30	U	0.32	U	0.31	U	**0.76**	**J**

Client Sample ID:	**USEPA Residential Screen Levels (November 2015)**	**USEPA Ecological Soil Screening Level**	**SS-19**		**SS-20**		**SS-21**		**SS-DUP-1**		**SS-DUP-2**	
Lab Sample ID:			**680-77458-15**		**680-77458-16**		**680-77458-17**		**680-77458-7**		**680-77458-13**	
Date Sampled:			**February 2012**		**February 2012**		**February 2012**		**February 2012**		**February 2012**	
Matrix:			**Soil**		**Soil**		**Soil**		**Soil**		**Soil**	
Aldrin	39	22	0.5	U	0.52	U	0.75	U	0.56	U	0.50	U
Dieldrin	34	22	0.31	U	0.32	U	0.47	U	0.35	U	0.31	U

Table 3
CCFTBR-H
Soil Analytical Results

Fort Bragg Garden Plot Sampling - December 2011																
Client Sample ID:	USEPA Residential Screen Levels (November 2015)	USEPA Ecological Soil Screening Level	S-1		S-2		S-3		S-4		S-5		S-6	
Lab Sample ID:			1112414-01		1112412-02		1112412-03		1112412-04		1112412-05		1112412-06	
Date Sampled:			December 2011		December 2011		December 2011		December 2011		December 2011		December 2011	
Matrix:			Soil		Soil		Soil		Soil		Soil		Soil	
Aldrin	39	22	<33	-	<33	-	<33	-	<33	-	44	-	<33	-
Dieldrin	34	22	73	-	22	-	60	-	250	-	250	-	58	-

Client Sample ID:	USEPA Residential Screen Levels (November 2015)	USEPA Ecological Soil Screening Level	S-7		S-8		S-9		S-10	
Lab Sample ID:			1112412-07		1112412-08		1112412-09		1112412-10	
Date Sampled:			December 2011		December 2011		December 2011		December 2011	
Matrix:			Soil		Soil		Soil		Soil	
Aldrin	39	22	<33	-	<33	-	<33	-	<33	-
Dieldrin	34	22	75	-	<1.6	-	13	-	9.7	-

Legend:	Exceed USEPA RSL	Exceed Ecological Soil Screening Level
All units in ug/kg.		

Golf Course Pesticide Site - SPLP vs. Total										
Client Sample ID:	USEPA Residential Screen Levels (November 2015)	USEPA Ecological Soil Screening Level	FB-GCP-SB01-S-3.0		FB-GCP-SB01-SL-3.0		FB-GCP-SB03-S-3.0		FB-GCP-SB03-S-3.0	
Lab Sample ID:			FA28900-13		FA25497-24		FA28900-12		FA25497-19	
Date Sampled:			10/27/2015		6/22/2015		10/27/2015		6/22/2015	
Matrix:			SPLP Soil (ug/L)		Soil		SPLP Soil (ug/L)		Soil	
Aldrin	39	22	0.0016	U	584	J	0.0064	U	135	-
Dieldrin	34	22	0.04	-	2290	-	0.94	-	834	-

Soil units in ug/kg.

SPLP units in ug/L.

APPENDIX A
HUMAN HEALTH
RISK ASSESSMENT TABLES

RAGS Table 1-1
SELECTION OF EXPOSURE PATHWAYS
Human Health Risk Assessment
Golf Course Pesticide Site
Fort Bragg, GA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Soil	Soil	Soil	Site Worker	Adult	Ingestion	On-Site	Quant	Direct contact with soil while working outdoors.
						Dermal	On-Site	Quant	Direct contact with soil while working outdoors
				Site Visitor	Adult	Ingestion	On-Site	Quant	Ingestion of soil tracked in from outside.
						Dermal	On-Site	None	No direct contact with soil while working indoors.
				On-Site Resident	Adult	Ingestion	On-Site	Quant	Direct contact with soil while at home.
						Dermal	On-Site	Quant	Direct contact with soil while at home.
					Child	Ingestion	On-Site	Quant	Direct contact with soil while at home.
						Dermal	On-Site	Quant	Direct contact with soil while at home.
		Soil to Air	Particulates/Vapors	Site Worker	Adult	Inhalation	On-Site	Quant	Exposure to airborne dust/vapor while working outside.
				Site Visitor	Adult	Inhalation	On-Site	None	No exposure to airborne dust/vapor while working indoors.
				On-Site Resident	Adult	Inhalation	On-Site	Quant	Exposure to airborne dust/vapor while at home.
					Child	Inhalation	On-Site	Quant	Exposure to airborne dust/vapor while at home.
Future	Groundwater	Groundwater	Groundwater	Site Worker	Adult	Ingestion	On-Site	Quant	Assumes use of groundwater as potable water supply.
						Dermal	On-Site	Quant	Assumes use of groundwater as potable water supply.
				Site Worker	Adult	Ingestion	On-Site	None	No exposure to groundwater while visiting site
						Dermal	On-Site	None	No exposure to groundwater while visiting site
				On-Site Resident	Adult	Ingestion	On-Site	Quant	Assumes use of groundwater as potable water supply.
						Dermal	On-Site	Quant	Assumes use of groundwater as potable water supply.
					Child	Ingestion	On-Site	Quant	Assumes use of groundwater as potable water supply.
						Dermal	On-Site	Quant	Assumes use of groundwater as potable water supply.
		Air	Groundwater	Site Worker	Adult	Inhalation	On-Site	None	Worker does not shower.
			Water Vapors at Showerhead	Site Visitor Worker	Adult	Inhalation	On-Site	None	No exposure to groundwater while visiting site
				On-Site Resident	Adult	Inhalation	On-Site	Quant	Assumes use of groundwater as potable water supply.
					Child	Inhalation	On-Site	Quant	Assumes use of groundwater as potable water supply.

RAGS Part D TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Soil
Exposure Point: Soil

CAS	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
0-6 inch BGS															
309-00-2	Aldrin	0.0015	0.40	mg/kg	SS-24	12/52	0.00048-0.033	0.4	N/A	0.039	C	N/A	N/A	YES	ASL
60-57-1	Dieldrin	0.00076	2.4	mg/kg	SS-24	24/52	0.0003-0.0879	2.4	N/A	0.034	C	N/A	N/A	YES	ASL
>0.5 - 2 ft BGS															
309-00-2	Aldrin	0.016	0.584	mg/kg	FB-GCP-SB01-SL-3.0	5/13	0.00052-0.0061	0.584	N/A	0.039	C	N/A	N/A	YES	ASL
60-57-1	Dieldrin	0.00065	2.6	mg/kg	SS-3-2'	7/13	0.00071-0.0074	2.6	N/A	0.034	C	N/A	N/A	YES	ASL
>2 ft BGS															
309-00-2	Aldrin	0.0039	0.0722	mg/kg	FB-GCP-SB03-SL-6.0	2/14	0.00052-0.0062	0.0722	N/A	0.039	C	N/A	N/A	YES	ASL
60-57-1	Dieldrin	0.00077	0.578	mg/kg	FB-GCP-SB03-SL-6.0	8/14	0.00063-0.00075	0.578	N/A	0.034	C	N/A	N/A	YES	ASL

(1) Maximum concentration used for screening.

(3) Screening value is the Residential Soil Values from the USEPA Novmember 2015 Regional Screening Levels (RSLs)
All screening levels were adjusted to a risk level of 1 x 10-6 or a HQ of 0.1 US(EPA, 2015).

(4) Rationale Codes:
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Below Screening Level (BSL)

Definitions: ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
C= Carcinogenic
mg/kg = Milligrams per kilogram
N = Non-Carcinogenic
N/A = Not Applicable

RAGS Part D TABLE 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Groundwater

CAS	Chemical	Minimum Concentration	Maximum Concentration	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (1)	Background Value (2)	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Y/N)	Rationale for Selection or Deletion (4)
309-00-2	Aldrin	0.012	0.14	µg/L	FB-GCP-MW04-GW	5/10	0.0016 - 0.021	0.14	N/A	0.00092	C	0.002	NCGWPS	YES	ASL
60-57-1	Dieldrin	0.0049	0.84	µg/L	FTBRH-MW-01	8/10	0.01	0.84	N/A	0.0018	C	0.002	NCGWPS	YES	ASL

(1) Maximum concentration used for screening.

(3) Screening value is the tap water from the USEPA Novemmber 2015 Regional Screening Levels (RSLs)
All screening levels were adjusted to a risk level of 1 x 10-6 or a HQ of 0.1 (USEPA, 2015).

(4) Rationale Codes:

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: Below Screening Level (BSL)

Definitions: ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

C= Carcinogenic

µg/L = Microgram per liter

N = Non-Carcinogenic

N/A = Not Applicable

MCL = Maximum contaminant level

NCGWPS= North Carolina Ground Water Protection Standards found in 15A NCAC 02L, October 2010 (aldrin) and April 2013

RAGS Part D TABLE 3.1

EXPOSURE POINT CONCENTRATION SUMMARY

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Medium: Soil and Groundwater
Exposure Medium: Soil and Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL	Maximum Concentration	Exposure Point Concentration (EPC)			
						Value	Units	Statistic	Rationale
Soil	Aldrin	mg/kg	0.02	0.05	0.40	0.05	mg/kg	95% Chebyshev (Mean, Sd)	4
0-6 in bgs	Dieldrin	mg/kg	0.13	0.48	2.40	0.48	mg/kg	97.5% Chebyshev (Mean, Sd)	4
Soil	Aldrin	mg/kg	0.09	0.60	0.58	0.58	mg/kg	Maximum concentration	5
>0.5 - 2 ft bgs	Dieldrin	mg/kg	0.48	2.46	2.60	2.46	mg/kg	95% Hall's Bootstrap	4
Soil	Aldrin	mg/kg	0.01	0.03	0.07	0.03	mg/kg	95% Chebyshev (Mean, Sd)	4
>2 ft bgs	Dieldrin	mg/kg	0.05	0.49	0.58	0.49	mg/kg	99% Chebyshev (Mean, Sd)	4
Soil	Aldrin	mg/kg	0.05	0.22	0.58	0.22	mg/kg	97.5% Chebyshev (Mean, Sd)	4
>6 in to 6 ft bgs	Dieldrin	mg/kg	0.27	1.55	2.60	1.55	mg/kg	99% Chebyshev (Mean, Sd)	4
Groundwater	Aldrin	µg/L	0.04	0.10	0.14	0.10	µg/L	95% Adjusted Gamma	1
	Dieldrin	µg/L	0.22	0.71	0.84	0.71	µg/L	95% Adjusted Gamma	1

The EPC is based on the lower of the 95% UCL and the maximum detected concentration.

(1) Based on ProUCL recommendation, data is gamma distributed.

(2) Based on ProUCL recommendation, data is lognormally distributed.

(3) Based on ProUCL recommendation, data is normally distributed.

(4) Data distribution is not discernable, UCL selection is based on ProUCL recommendation.

(5) ProUCL recommended UCL exceeds the maximum observation.

mg/kg = milligram per kilogram

ND = Not Discernable. Data do not follow a discernable distribution.

UCL = upper confidence limit

µg/L = microgram per liter

RAGS Part D Table 4-1
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
HHRA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil & Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Site Worker (Current/Future)	Adult	Soil	EPC	Exposure Point Concentration	Chemical Specific	mg/kg	[1] See RAGS Part D Table 3-1	Chronic Daily Intake (CDI)(mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2002; outdoor worker	EPC x IR-S x CF x FI x EF x ED x 1/BW x 1/AT
				FI	Fraction Ingested	1	unitless	EPA, 1989	
				EF	Exposure Frequency	250	days/year	EPA, 2002	
				ED	Exposure Duration	25	years	EPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Site Visitor (Current/Future)	Adult	Soil	EPC	Exposure Point Concentration	Chemical Specific	mg/kg	[1] See RAGS Part D Table 3-1	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2002; outdoor worker	EPC x IR-S x CF x FI x EF x ED x 1/BW x 1/AT
				FI	Fraction Ingested	1	unitless	EPA, 1989	
				EF	Exposure Frequency	100	days/year	Professional judgement (2 days/week for 50 weeks)	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
	Resident (Future)	Child/Adult (Cancer Only)	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IFS_{adj}	Age-adjusted soil ingestion factor	105	mg-year/kg-day	Calculated	$EPC \times IFS_{adj} \times CF \times FI \times EF \times 1/AT$
				FI	Fraction Ingested	1	unitless	EPA, 1989	Where
				EF	Exposure Frequency	350	days/year	EPA, 2002	$IFS_{adj} = (IRS_c \times ED_c \times 1/BW_c) + (IRS_a \times ED_a \times 1/BW_a)$
				ED_c	Exposure Duration - child	6	years	EPA, 2002	
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	
				IRS_c	Ingestion Rate of Soil - child	200	mg/day	EPA, 1989	
				IRS_a	Ingestion Rate of Soil - adult	100	mg/day	EPA, 1989	
				BW_c	Body Weight - child	15	kg	EPA, 1989	
				BW_a	Body Weight - adult	80	kg	EPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 2002	EPC x IR-S x CF x FI x EF x ED x 1/BW x 1/AT
				FI	Fraction Ingested	1	unitless	EPA, 1989	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_c	Exposure Duration - child	6	years	EPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				BW	Body Weight	15	kg	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Adult	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 2002	EPC x IR-S x CF x FI x EF x ED x 1/BW x 1/AT
				FI	Fraction Ingested	1	unitless	EPA, 1989	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adult	7,300	days	EPA, 1989	

]

RAGS Part D Table 4-1
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
HHRA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soil & Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Site Worker (Current/Future)	Adult	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SA	Exposed Skin Surface Area	3,527	cm^2/day	EPA, 2015	EPC x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
				SSAF	Soil to Skin Adherence Factor	0.12	mg/cm^2	EPA, 2015	
				EF	Exposure Frequency	250	days/year	EPA, 2002	
				ED	Exposure Duration	25	years	EPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				DABS	Dermal Absorption Factor	0.1	unitless	EPA, 2015; dieldrin; no value aldrin	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Site Visitor (Current/Future)	Adult	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SA	Exposed Skin Surface Area	6,032	cm^2/day	EPA, 2015; adult resident	EPC x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2	EPA, 2015; adult resident	
				EF	Exposure Frequency	100	days/year	Professional judgement (2 days/week for 50 weeks)	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				DABS	Dermal Absorption Factor	0.1	unitless	EPA, 2015; dieldrin; no value aldrin	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	3,285	days	ED x 365 days/yr	
	Resident (Future)	Child/Adult (Cancer Only)	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SFS_{adj}	Age-adjusted dermal factor	295	mg-year/kg-day	Calculated	EPC x SFS_{adj} x DABS x CF x EF x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 2002	Where
				ED_c	Exposure Duration - child	6	years	EPA, 2002	SFS_{adj} = (SA_c x AF_c x ED_c x 1/BW_c) +
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	(SA_a x AF_a x ED_a x 1/BW_a)
				SA_c	Exposed Skin Surface Area - child	2,373	cm^2/day	EPA, 2015	
				SA_a	Exposed Skin Surface Area - adult	6,032	cm^2/day	EPA, 2015	
				$SSAF_c$	Soil to Skin Adherence Factor - child	0.2	mg/cm^2	EPA, 2004	
				$SSAF_a$	Soil to Skin Adherence Factor - adult	0.07	mg/cm^2	EPA, 2004	
				DABS	Dermal Absorption Factor	0.1	unitless	EPA, 2015; dieldrin; no value aldrin	
				BW_c	Body Weight - child	15	kg	EPA, 1989	
				BW_a	Body Weight - adult	80	kg	EPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SA	Exposed Skin Surface Area	2,373	cm^2/day	EPA, 2015	EPC x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_c	Exposure Duration - child	6	years	EPA, 2002	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				DABS	Dermal Absorption Factor	0.1	unitless	EPA, 2015; dieldrin; no value aldrin	
				BW	Body Weight	15	kg	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Adult	Soil	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SA	Exposed Skin Surface Area	6,032	cm^2/day	EPA, 2015	EPC x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	
				CF	Conversion Factor	1.00E-06	kg/mg	-----	
				DABS	Dermal Absorption Factor	0.1	unitless	EPA, 2015; dieldrin; no value aldrin	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adult	7,300	days	EPA, 1989	

[1] The EPC is based on the 95% UCL.

[2] 50th percentile residential occupancy period (EPA, 2011; Table 16-108)

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Site. OSWER 9355-4.24..

EPA: 2004. Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005.

EPA. 2011. Exposure Factors Handbook, 2011 Update. National Center for Environmental Assessment. EPA/600/R-09/052F

EPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. FEB 6.

EPA, 2015. Regional screening level (RSL) User's Guide and On-line Calculator (https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015)

RAGS PART D Table 4-2
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
HHRA

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name (1)
Inhalation	Site Worker (Outdoor)	Adult	Airborne Dust/Particulates/Vapors	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	8	hours/day	EPA, 2009	EPC x ET x EF x ED x 1/PEF (or 1/VF) x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 2002	
				ED	Exposure Duration	25	years	EPA, 2002	
				PEF	Particulate Emissions Factor	5.93E+10	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone)	
				VF	Volatilization Factor	1.80E+06	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone); aldrin; dieldrin not volatile	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				AT-NC	Averaging Time (Non-Cancer)	219,000	hours	EPA, 1989, 2009	
	Site Visitor	Adult	Airborne Dust/Particulates/Vapors	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	8	hours/day	EPA, 2009	EPC x ET x EF x ED x 1/PEF (or 1/VF) x 1/AT
				EF	Exposure Frequency	100	days/year	Professional judgement (5 days/week for 50 weeks)	
				ED	Exposure Duration	9	years	EPA, 2011 (2)	
				PEF	Particulate Emissions Factor	5.93E+10	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone)	
				VF	Volatilization Factor	1.80E+06	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone); aldrin; dieldrin not volatile	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				AT-NC	Averaging Time (Non-Cancer)	78,840	hours	EPA, 1989, 2009	
	Resident	Child/Adult (Cancer Only)	Airborne Dust/Particulates/Vapors	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ED_{adj}	Exposure Duration - Child + Adult	26	years	Calculated	EPC x ED_{adj} x EF x 1/PEF (or 1/VF) x 1/AT
				ET	Exposure time	24	hours/day	EPA, 2009	
				EF	Exposure Frequency	350	days/year	EPA, 2002	Where
				PEF	Particulate Emissions Factor	5.93E+10	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone)	ED_{adj} = (ED_c) + (ED_a)
				VF	Volatilization Factor	1.80E+06	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone); aldrin; dieldrin not volatile	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
		Child	Airborne Dust/Particulates/Vapors	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	24	hours/day	EPA, 2009	
				EF	Exposure Frequency	350	days/year	EPA, 2002	EPC x ET x EF x ED x 1/PEF (or 1/VF) x 1/AT
				ED_c	Exposure Duration-child	6	years	EPA, 2002	
				PEF	Particulate Emissions Factor	5.93E+10	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone)	
				VF	Volatilization Factor	1.80E+06	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone); aldrin; dieldrin not volatile	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				AT-NC	Averaging Time (Non-Cancer)	52,560	hours	EPA, 1989, 2009	
		Adult	Airborne Dust/Particulates /Vapors	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	24	hours/day	EPA, 2009	
				EF	Exposure Frequency	350	days/year	EPA, 2002	EPC x ET x EF x ED x 1/PEF (or 1/VF) x 1/AT
				ED_a	Exposure Duration-adult	20	years	EPA, 2014	
				PEF	Particulate Emissions Factor	5.93E+10	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone)	
				VF	Volatilization Factor	1.80E+06	m^3/kg	EPA, 2015; RSL calculator (Raleigh NC climate zone); aldrin; dieldrin not volatile	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adul	175,200	hours	EPA, 1989, 2009	

[1] The EPC is based on the 95% UCL.

[2] 50th percentile residential occupancy period (EPA, 2011; Table 16-108)

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Site. OSWER 9355-4.24..

EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA/540/R/070/002.

EPA. 2011. Exposure Factors Handbook, 2011 Update. National Center for Environmental Assessment. EPA/600/R-09/052F

EPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. FEB 6.

EPA, 2015. Regional screening level (RSL) User's Guide (https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015)

RAGS PART D Table 4-3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

HHRA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Site Worker (Current/Future)	Adult	Tap Water	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IR-GW	Ingestion Rate of Groundwater	2.5	L/day	EPA, 2014	EPC x IR-GW x CF x EF x ED x 1/BW x 1/AT
				CF	Conversion Factor	1.00E-03	mg/µg	-----	
				EF	Exposure Frequency	250	days/year	EPA, 2002	
				ED	Exposure Duration	25	years	EPA, 2002	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Resident (Future)	Child/Adult (Cancer Only)	Tap Water	EPC	Exposure Point Concentration	Chemical-specific	mg/kg	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				$IF\text{-}GW_{adj}$	Age-adjusted tap water ingestion factor-default	0.94	L/kg	Calculated	$EPC \times IF\text{-}GW_{adj} \times CF \times EF \times 1/AT$
				EF	Exposure Frequency	350	days/year	EPA, 2002	Where
				ED_c	Exposure Duration - child	6	years	EPA, 2002	$IF\text{-}GW_{adj} = (IR\text{-}GW_c \times ED_c \times 1/BW_c) + (IR\text{-}GW_a \times ED_a \times 1/BW_a)$
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	
				$IR\text{-}GW_c$	Ingestion Rate of Groundwater - child	0.78	L/day	EPA, 2014	
				$IR\text{-}GW_a$	Ingestion Rate of Groundwater - adult	2.5	L/day	EPA, 2014	
				BW_c	Body Weight - child	15	kg	EPA, 1989	
				BW_a	Body Weight - adult	80	kg	EPA, 2014	
				CF	Conversion Factor	1.00E-03	mg/µg	-----	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Tap Water	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IR-GW	Ingestion Rate of Groundwater	0.78	L/day	EPA, 2014	EPC x IR-GW x CF x EF x ED x 1/BW x 1/AT
				CF	Conversion Factor	1.00E-03	mg/µg	-----	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED	Exposure Duration	6	years	EPA, 2002	
				BW	Body Weight	15	kg	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

RAGS PART D Table 4-3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

HHRA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion (continued)	Resident (Future)	Adult	Tap Water	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Chronic daily intake (CDI)(mg/kg-day) =
				IR-GW	Ingestion Rate of Groundwater	2.5	L/day	EPA, 2014	EPC x IR-GW x CF x EF x ED x 1/BW x 1/AT
				CF	Conversion Factor	1.00E-03	mg/µg	-----	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED	Exposure Duration	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adult	7,300	days	EPA, 1989	
Dermal	Site Worker (Current/Future)	Adult	Tap Water While Handwashing	SA	Skin Surface Area Available for Contact	980	cm^2	EPA, 2011 (2)	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				DA_{EVENT}	Absorbed Dose Per Event	Chemical-specific	mg/cm^2-event	EPA, 2004; See RAGS Part D Table 4-5	DA_{EVENT} x EV x SA x EF x ED x 1/BW x 1/AT
				EV	Event Frequency	1	event/day	EPA, 2004	
				EF	Exposure Frequency	250	days/year	EPA, 2002	
				ED	Exposure Duration	25	years	EPA, 2002	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
				FA	Fraction Absorbed Water	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	if $t_{event} \leq t^*$, then DA_{EVENT} (Organic) =
				K_p	Dermal Permeability Coefficient	Chemical-specific	cm/hour	EPA, 2004; See RAGS Part D Table 4-5	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
				C_w	Chemical Concentration in Water	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	
				CF_1	Conversion Factor	1.0E-03	mg/µg	-----	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
				CF_2	Conversion Factor	1.0E-03	L/cm^3	-----	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	$[((t_{event})/(1+B)) + 2\tau_{event}\ ((1 + 3B + 3B^2)/(1+B)^2)$
				t^*	Time to Reach Steady State	Chemical-specific	hour	EPA, 2004; See RAGS Part D Table 4-5	
				τ_{event}	Lag Time Per Event	Chemical-specific	hr/event	EPA, 2004; See RAGS Part D Table 4-5	
				t_{event}	Event Duration	0.08	hr/event	EPA 1997 & Professional judgement [2]	

RAGS PART D Table 4-3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

HHRA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Resident (Future)	Child/Adult (Cancer Only)	Tap Water While Bathing/ Showering	SFW_{adj}	Age-adjusted dermal tap water factor	7,459	cm^2	Calculated	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				SA_c	Skin Surface Area Available for Contact - child	6,365	cm^2	EPA, 2015	SFW_{adj} x DA_{EVENT} x EV x EF x 1/AT
				SA_a	Skin Surface Area Available for Contact - adult	19,652	cm^2	EPA, 2015	Where
				ED_c	Exposure Duration - child	6	years	EPA, 2002	$SFW_{adj} = (SA_c \times ED_c \times 1/BW_c) +$
				ED_a	Exposure Duration - adult	20	years	EPA, 2014	$(SA_a \times ED_a \times 1/BW_a)$
				BW_c	Body Weight - child	15	kg	EPA, 1989	
				BW_a	Body Weight - adult	80	kg	EPA, 2014	
				DA_{EVENT}	Absorbed Dose Per Event	Chemical-specific	mg/cm^2-event	EPA, 2004; See RAGS Part D Table 4-5	
Dermal (continued)	Resident (Future)	Child/Adult (Cancer Only)	Tap Water While Bathing/ Showering	EV	Event Frequency	1	event/day	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child/Adult (Cancer Only)	Tap Water While Bathing/ Showering	FA	Fraction Absorbed Water	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	if $t_{event} \leq t^*$, then DA_{EVENT} (Organic) =
				K_p	Dermal Permeability Coefficient	Chemical-specific	cm/hour	EPA, 2004; See RAGS Part D Table 4-5	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
				C_w	Chemical Concentration in Water	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	
				CF_1	Conversion Factor	1.0E-03	mg/µg	-----	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
				CF_2	Conversion Factor	1.0E-03	L/cm^3	-----	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	$[((t_{event})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
				t*	Time to Reach Steady State	Chemical-specific	hour	EPA, 2004; See RAGS Part D Table 4-5	
				τ_{event}	Lag Time Per Event	Chemical-specific	hr/event	EPA, 2004; See RAGS Part D Table 4-5	
				$t_{event-c}$	Event Duration - child	1.00	hr/event	EPA, 2004	
				$t_{event-adj}$	Event Duration-age-adjusted	0.66	hr/event	EPA, 2004	
		Child	Tap Water While Bathing/	SA	Skin Surface Area Available for Contact	6,365	cm^2	EPA, 2015	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				DA_{EVENT}	Absorbed Dose Per Event	Chemical-specific	mg/cm^2-event	EPA, 2004; See RAGS Part D Table 4-5	DA_{EVENT} x EV x SA x EF x ED x 1/BW x 1/AT
				EV	Event Frequency	1	event/day	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_c	Exposure Duration-child	6	years	EPA, 2002	
				BW	Body Weight	15	kg	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				FA	Fraction Absorbed Water	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	if $t_{event} \leq t^*$, then DA_{EVENT} (Organic) =
				K_p	Dermal Permeability Coefficient	Chemical-specific	cm/hour	EPA, 2004; See RAGS Part D Table 4-5	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
				C_w	Chemical Concentration in Water	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	
				CF_1	Conversion Factor	1.0E-03	mg/µg	-----	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
				CF_2	Conversion Factor	1.0E-03	L/cm^3	-----	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	$[((t_{event})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
				t*	Time to Reach Steady State	Chemical-specific	hour	EPA, 2004; See RAGS Part D Table 4-5	
				τ_{event}	Lag Time Per Event	Chemical-specific	hr/event	EPA, 2004; See RAGS Part D Table 4-5	
				t_{event}	Event Duration	0.54	hr/event	EPA, 2014	

RAGS PART D Table 4-3

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

HHRA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident (Future)	Adult	Tap Water While Showering	SA	Skin Surface Area Available for Contact	19,652	cm^2	EPA, 2015	Dermally Absorbed Dose (DAD)(mg/kg-day) =
				DA_{EVENT}	Absorbed Dose Per Event	Chemical-specific	mg/cm^2-event	EPA, 2004; See RAGS Part D Table 4-5	DA_{EVENT} x EV x SA x EF x ED x 1/BW x 1/AT
				EV	Event Frequency	1	event/day	EPA, 2004	
				EF	Exposure Frequency	350	days/year	EPA, 2002	
				ED_a	Exposure Duration-adult	20	years	EPA, 2014	
				BW	Body Weight	80	kg	EPA, 2014	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adult	7,300	days	EPA, 1989	
				FA	Fraction Absorbed Water	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	if $t_{event} \leq t^*$, then DA_{EVENT} (Organic) =
				K_p	Dermal Permeability Coefficient	Chemical-specific	cm/hour	EPA, 2004; See RAGS Part D Table 4-5	$2\ FA \times K_p \times C_w \times CF_1 \times CF_2 \times \sqrt{(6\tau_{event} \times t_{event}/\pi)}$
				C_w	Chemical Concentration in Water	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	
				CF_1	Conversion Factor	1.0E-03	mg/µg	-----	otherwise if $t_{event} > t^*$, then DA_{EVENT} (Organic) =
				CF_2	Conversion Factor	1.0E-03	L/cm^3	-----	$FA \times K_p \times C_w \times CF_1 \times CF_2 \times$
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	EPA, 2004; See RAGS Part D Table 4-5	$[((t_{event})/(1+B)) + 2\tau_{event}((1 + 3B + 3B^2)/(1+B)^2)$
				t^*	Time to Reach Steady State	Chemical-specific	hour	EPA, 2004; See RAGS Part D Table 4-5	
				τ_{event}	Lag Time Per Event	Chemical-specific	hr/event	EPA, 2004; See RAGS Part D Table 4-5	
				t_{event}	Event Duration	0.71	hr/event	EPA, 2014	

[1] The EPC is based on the 95UCL.

[2] based on washing hands 9.5 times per day at work, for a 0.5 minutes per washing, for a total of 4.75 minutes per day

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA, 1997. ERA Guidance for Superfund: Process for Designing and Conducting ERAs. Interim Final. Washington, DC. EPA/540/R-97/006. June.

EPA 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Site. OSWER 9355-4.24..

EPA: 2004. Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005.

EPA. 2011. Exposure Factors Handbook, 2011 Update. National Center for Environmental Assessment. EPA/600/R-09/052F

EPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. FEB 6.

EPA, 2015. Regional screening level (RSL) User's Guide (https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015)

RAGS PART D Table 4-4

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

HHRA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name (1)
	Resident	Child/Adult (Cancer Only)	Water Vapors	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ED_{adj}	Exposure Duration - Child + Adult	26	years	Calculated	EPC x 1E-03 mg/ug x ED_{adj} x EF x K
				ET	Exposure time	24	hours/day	EPA, 2014; 2015	
				EF	Exposure Frequency	350	days/year	EPA, 2014; 2015	
				K	Andelman Volatilization Factor (L/m3)	5.00E-01	L/m^3	EPA, 2014; 2015	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
		Child	Water Vapors	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	24	hours/day	EPA, 2014; 2015	
				EF	Exposure Frequency	350	days/year	EPA, 2014; 2015	EPC x 1E-03 mg/ug x ET x 1 day/24 hr x EF x ED x K x 1/AT
				ED_c	Exposure Duration-child	6	years	EPA, 2014; 2015	
				K	Andelman Volatilization Factor (L/m3)	5.00E-01	L/m^3	EPA, 2014; 2015	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				AT-NC	Averaging Time (Non-Cancer)	52,560	hours	EPA, 1989, 2009	
		Adult	Water Vapors	EPC	Exposure Point Concentration	Chemical-specific	µg/L	[1] See RAGS Part D Table 3-1	Exposure Concentration (EC)(mg/m^3) =
				ET	Exposure time	24	hours/day	EPA, 2014; 2015	
				EF	Exposure Frequency	350	days/year	EPA, 2014; 2015	EPC x 1E-03 mg/ug x ET x 1 day/24 hr x EF x ED x K x 1/AT
				ED_a	Exposure Duration-adult	20	years	EPA, 2014; 2015	
				K	Andelman Volatilization Factor (L/m3)	5.00E-01	L/m^3	EPA, 2014; 2015	
				AT-C	Averaging Time (Cancer)	613,200	hours	EPA, 1989, 2009	
				$AT\text{-}NC_a$	Averaging Time (Non-Cancer)-adult	175,200	hours	EPA, 1989, 2009	

EPA 1989: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part A. OERR EPA/540/1-89/002.

EPA 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA/540/R/070/002.

EPA, 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. FEB 6.

EPA, 2015. Regional screening level (RSL) User's Guide (https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015)

RAGS PART D Table 4-5

Dermally Absorbed Dose per Event (DA_{event}) Calculations[a]
Groundwater

COPC	Concentration Water (ug/L)	Concentration Water (mg/m3)	FA (unitless)	K_p (cm/hr)	τ_{event} (hr/event)	B (unitless)	t^* (hr)	DA_{event} (mg/cm^2-event)[b] Age-adjusted Resident	Child Resident	Adult Resident	Site Worker
Dieldrin	1	0.000001	8.00E-01	3.26E-02	1.43E+01	2.45E-01	3.43E+01	2.23E-07	2.00E-07	2.30E-07	7.71E-08
Aldrin	1	0.000001	1.00E+00	2.93E-01	1.16E+01	2.15E+00	4.77E+01	NA	NA	NA	NA

[a] EPA, 2004

[b] Calculated using EPA RSL online calculator based on Equation 3.2 or 3.3 for organics in EPA, 2004b where t_{event} equals 0.54 for child residents, 0.71 for adult resident, 0.6708 for age-adjusted resident, and 0.08 for site worker

B = Ratio of the permeability coefficient of a COPC through the stratum corneum relative to its permeability coefficient across the viable epidermis.

FA = Fraction absorbed.

K_p = Dermal permeability coefficient.

NA = Not applicable.

τ_{event} = Lag time per event.

t^* = Time to reach steady-state.

RAGS Part D TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Human Health Risk Assessment

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (1)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (2) (MM/DD/YYYY)
Pesticides										
Aldrin	Chronic	3.00E-05	mg/kg/day	1.00E+00	3.00E-05	mg/kg/day	Liver	1,000	IRIS	4/20/2016
Dieldrin	Chronic	5.00E-05	mg/kg/day	1.00E+00	5.00E-05	mg/kg/day	Liver	100	IRIS	4/20/2016

(1) EPA, 2015. Dermal RfD derived by multiplying the oral absorption efficiency factor by the oral RfD. Definitions: IRIS=Integrated Risk Information System.

(2) Represents date source was searched. NA=Not available.

RAGS Part D TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

Human Health Risk Assessment

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (1) (MM/DD/YYYY)
Pesticides									
Aldrin		NA	mg/m3	NA	mg/m3	NA	NA	IRIS	4/20/2016
Dieldrin		NA	mg/m3	NA	mg/m3	NA	NA	IRIS	4/20/2016

(1) Represents date source was searched.

Definitions: IRIS=Integrated Risk Information System
NA=Not available
RfD = reference dose

RAGS Part D TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Human Health Risk Assessment

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (1)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (2) (MM/DD/YYYY)
Aldrin	1.70E+01	1/mg/kg/day	1.00E+00	1.70E+01	1/mg/kg/day	B2	IRIS	4/20/2016
Dieldrin	1.60E+01	1/mg/kg/day	1.00E+00	1.60E+01	1/mg/kg/day	B2	IRIS	4/20/2016

(1) EPA, 2015. Dermal SF derived by dividing the oral SF by the oral absorption efficiency factor.

(2) Represents date source was searched.

Definitions:

IRIS - Integrated Risk Information System

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

RAGS Part D TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

Human Health Risk Assessment

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (1) (MM/DD/YYYY)
Aldrin	4.90E-03	1/µg/m3	NA	1/µg/m3	B2	IRIS	4/20/2016
Dieldrin	4.60E-03	1/µg/m3	NA	1/µg/m3	B2	IRIS	4/20/2016

(1) Represents date source w

Definitions: IRIS = Integrated Risk Information System.

NA = Not available.

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans.

RAGS Part D TABLE 7-1

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS for Site Worker Expsoure to Surface Soil

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil (0-6 inch bgs)	Ingestion	Aldrin	0.05	mg/kg	1.63E-08	mg/kg/day	1.70E+01	1/mg/kg/day	2.76E-07	4.55E-08	mg/kg/day	3.0E-05	mg/kg/day	1.52E-03
				Dieldrin	0.48	mg/kg	1.46E-07	mg/kg/day	1.60E+01	1/mg/kg/day	2.33E-06	4.07E-07	mg/kg/day	5.0E-05	mg/kg/day	8.15E-03
			Exp. Route Total								2.60E-06					9.67E-03
			Dermal	Aldrin	0.05	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.48	mg/kg	6.16E-08	mg/kg/day	1.60E+01	1/mg/kg/day	9.85E-07	1.72E-07	mg/kg/day	5.0E-05	mg/kg/day	3.45E-03
			Exp. Route Total								9.9E-07					3.45E-03
		Exposure Point Total									3.59E-06					1.31E-02
	Exposure Medium Total										3.59E-06					1.31E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.05	mg/kg	2.41E-09	mg/m^3	4.90E+00	$1/mg/m^3$	1.18E-08	6.74E-09	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.48	mg/kg	6.54E-13	mg/m^3	4.60E+00	$1/mg/m^3$	3.01E-12	1.83E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								1.18E-08					0.00E+00
		Exposure Point Total									1.18E-08					0.00E+00
	Exposure Medium Total										1.18E-08					0.00E+00
Soil Total											3.60E-06					1.31E-02
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	7.48E-07	mg/kg/day	1.70E+01	1/mg/kg/day	1.27E-05	2.10E-06	mg/kg/day	3.0E-05	mg/kg/day	6.98E-02
				Dieldrin	0.71	µg/L	5.46E-06	mg/kg/day	1.60E+01	1/mg/kg/day	8.73E-05	1.53E-05	mg/kg/day	5.0E-05	mg/kg/day	3.06E-01
			Exp. Route Total								1.00E-04					3.75E-01
			Dermal	Aldrin	0.10	µg/L	NA	mg/kg/day	1.70E+01	1/mg/kg/day	NA	NA	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.71	µg/L	1.65E-07	mg/kg/day	1.60E+01	1/mg/kg/day	2.64E-06	4.62E-07	mg/kg/day	5.0E-05	mg/kg/day	9.24E-03
			Exp. Route Total								2.64E-06					9.24E-03
		Exposure Point Total									1.03E-04					3.85E-01
	Exposure Medium Total										1.03E-04					3.85E-01
Groundwater Total											1.03E-04					3.85E-01
											Total of Receptor Risks Across Soils and Groundwater					
											1.06E-04	Total of Receptor Hazards Across All Media				3.98E-01

NA = Not applicable.

RAGS Part D TABLE 7-2

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil (0-6 inch bgs)	Ingestion	Aldrin	0.05	mg/kg	2.34E-09	mg/kg/day	1.70E+01	1/mg/kg/day	3.98E-08	4.55E-08	mg/kg/day	3.0E-05	mg/kg/day	1.52E-03
				Dieldrin	0.48	mg/kg	2.10E-08	mg/kg/day	1.60E+01	1/mg/kg/day	3.35E-07	4.07E-07	mg/kg/day	5.0E-05	mg/kg/day	8.15E-03
			Exp. Route Total								3.75E-07					9.67E-03
			Dermal	Aldrin	0.05	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.48	mg/kg	8.85E-09	mg/kg/day	1.60E+01	1/mg/kg/day	1.42E-07	6.88E-08	mg/kg/day	5.0E-05	mg/kg/day	1.38E-03
			Exp. Route Total								1.42E-07					1.38E-03
		Exposure Point Total									5.17E-07					1.10E-02
	Exposure Medium Total										5.17E-07					1.10E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.05	mg/kg	3.47E-10	mg/m^3	4.90E+00	$1/mg/m^3$	1.70E-09	2.70E-09	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.48	mg/kg	9.42E-14	mg/m^3	4.60E+00	$1/mg/m^3$	4.33E-13	7.33E-13	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								1.70E-09					0.00E+00
		Exposure Point Total									1.70E-09					0.00E+00
	Exposure Medium Total										1.70E-09					0.00E+00
Soil Total											5.18E-07					1.10E-02
											Total of Receptor Risks Across Soils and Groundwater					
											5.18E-07					1.10E-02
												Total of Receptor Hazards Across All Media				

NA = Not applicable.

RAGS Part D TABLE 7-3

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil (0-6 inch bgs)	Ingestion	Aldrin	0.05	mg/kg						6.37E-08	mg/kg/day	3.0E-05	mg/kg/day	2.12E-03
				Dieldrin	0.48	mg/kg						5.70E-07	mg/kg/day	5.0E-05	mg/kg/day	1.14E-02
			Exp. Route Total								---					1.35E-02
			Dermal	Aldrin	0.05	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.48	mg/kg						2.41E-07	mg/kg/day	5.0E-05	mg/kg/day	4.82E-03
			Exp. Route Total								---					4.82E-03
		Exposure Point Total									---					1.83E-02
	Exposure Medium Total										---					1.83E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.05	mg/kg						7.69E-12	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.48	mg/kg						7.69E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.83E-02
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						2.93E-06	mg/kg/day	3.0E-05	mg/kg/day	9.78E-02
				Dieldrin	0.71	µg/L						2.14E-05	mg/kg/day	5.0E-05	mg/kg/day	4.28E-01
			Exp. Route Total								---					5.26E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						3.86E-05	mg/kg/day	5.0E-05	mg/kg/day	7.72E-01
			Exp. Route Total								---					7.72E-01
		Exposure Point Total									---					1.30E+00
	Exposure Medium Total										---					1.30E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					1.30E+00
Groundwater Total											---					1.30E+00
											Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media 1.32E+00

NA = Not applicable.

RAGS Part D TABLE 7-4

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil (0-6 inch bgs)	Ingestion	Aldrin	0.05	mg/kg						6.80E-07	mg/kg/day	3.0E-05	mg/kg/day	2.27E-02
				Dieldrin	0.48	mg/kg						6.08E-06	mg/kg/day	5.0E-05	mg/kg/day	1.22E-01
			Exp. Route Total								---					1.44E-01
			Dermal	Aldrin	0.05	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.48	mg/kg						1.44E-06	mg/kg/day	5.0E-05	mg/kg/day	2.89E-02
			Exp. Route Total								---					2.89E-02
		Exposure Point Total									---					1.73E-01
	Exposure Medium Total										---					1.73E-01
	Particulates/Vapors	Air	Inhalation	Aldrin	0.05	mg/kg						7.69E-12	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.48	mg/kg						7.69E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.73E-01
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						4.88E-06	mg/kg/day	3.0E-05	mg/kg/day	1.63E-01
				Dieldrin	0.71	µg/L						3.56E-05	mg/kg/day	5.0E-05	mg/kg/day	7.12E-01
			Exp. Route Total								---					8.75E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						5.82E-05	mg/kg/day	5.0E-05	mg/kg/day	1.16E+00
			Exp. Route Total								---					1.16E+00
		Exposure Point Total									---					2.04E+00
	Exposure Medium Total										---					2.04E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					2.04E+00
Groundwater Total											---					2.04E+00
											Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media 2.21E+00

NA = Not applicable.

RAGS Part D TABLE 7-5

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Age-Adjusted (Child/Adult)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Surface Soil	Surface Soil (0-6 inch bgs)	Ingestion	Aldrin	0.05	mg/kg	7.64E-08	mg/kg/day	1.70E+01	NA	1.30E-06					
				Dieldrin	0.48	mg/kg	6.85E-07	mg/kg/day	1.60E+01	1/mg/kg/day	1.10E-05					
			Exp. Route Total								1.23E-05					---
			Dermal	Aldrin	0.05	mg/kg	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00					
				Dieldrin	0.48	mg/kg	1.93E-07	mg/kg/day	1.60E+01	1/mg/kg/day	3.08E-06					
			Exp. Route Total								3.08E-06					---
		Exposure Point Total									1.53E-05					---
	Exposure Medium Total										1.53E-05					---
	Particulates/Vapors	Air	Inhalation	Aldrin	0.05	mg/kg	1.05E-08	mg/m^3	4.90E+00	$1/mg/m^3$	5.15E-08					
				Dieldrin	0.48	mg/kg	2.86E-12	mg/m^3	4.60E+00	$1/mg/m^3$	1.31E-11					
			Exp. Route Total								5.15E-08					---
		Exposure Point Total									5.15E-08					---
	Exposure Medium Total										5.15E-08					---
Soil Total											1.54E-05					---
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	1.26E-06	mg/kg/day	1.70E+01	1/mg/kg/day	2.14E-05	---	---	---	---	---
				Dieldrin	0.71	µg/L	9.16E-06	mg/kg/day	1.60E+01	1/mg/kg/day	1.47E-04					
			Exp. Route Total								1.68E-04					---
			Dermal	Aldrin	0.10	µg/L	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00	---	---	---	---	---
				Dieldrin	0.71	µg/L	1.63E-05	mg/kg/day	1.60E+01	1/mg/kg/day	2.61E-04					
			Exp. Route Total								2.61E-04					---
		Exposure Point Total									4.29E-04					---
	Exposure Medium Total										4.29E-04					---
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L	1.74E-05	mg/m^3	4.90E+00	$1/mg/m^3$	8.54E-05					
				Dieldrin	0.71	µg/L		mg/m^3	4.60E+00	$1/mg/m^3$	0.00E+00					
			Exp. Route Total								8.54E-05					---
		Exposure Point Total									8.54E-05					---
	Exposure Medium Total										5.14E-04					---
Groundwater Total											5.14E-04					---
										Total of Receptor Risks Across Soils and Groundwater	5.29E-04	Total of Receptor Hazards Across All Media				---

NA = Not applicable.

RAGS Part D TABLE 7-6

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS for Site Worker Expsoure to Surface Soil

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Shallow Soil	Shallow Soil (>6 inch - 2 ft bgs)	Ingestion	Aldrin	0.58	mg/kg	1.79E-07	mg/kg/day	1.70E+01	1/mg/kg/day	3.04E-06	5.00E-07	mg/kg/day	3.0E-05	mg/kg/day	1.67E-02
				Dieldrin	2.46	mg/kg	7.53E-07	mg/kg/day	1.60E+01	1/mg/kg/day	1.20E-05	2.11E-06	mg/kg/day	5.0E-05	mg/kg/day	4.22E-02
			Exp. Route Total								1.51E-05					5.88E-02
			Dermal	Aldrin	0.58	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	2.46	mg/kg	3.19E-07	mg/kg/day	1.60E+01	1/mg/kg/day	5.10E-06	8.93E-07	mg/kg/day	5.0E-05	mg/kg/day	1.79E-02
			Exp. Route Total								5.1E-06					1.79E-02
		Exposure Point Total									2.02E-05					7.67E-02
	Exposure Medium Total										2.02E-05					7.67E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.58	mg/kg	2.65E-08	mg/m^3	4.90E+00	$1/mg/m^3$	1.30E-07	7.41E-08	mg/m^3	NA	mg/m^3	NA
				Dieldrin	2.46	mg/kg	3.39E-12	mg/m^3	4.60E+00	$1/mg/m^3$	1.56E-11	9.48E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								1.30E-07					0.00E+00
		Exposure Point Total									1.30E-07					0.00E+00
	Exposure Medium Total										1.30E-07					0.00E+00
Soil Total											2.03E-05					7.67E-02
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	7.48E-07	mg/kg/day	1.70E+01	1/mg/kg/day	1.27E-05	2.10E-06	mg/kg/day	3.0E-05	mg/kg/day	6.98E-02
				Dieldrin	0.71	µg/L	5.46E-06	mg/kg/day	1.60E+01	1/mg/kg/day	8.73E-05	1.53E-05	mg/kg/day	5.0E-05	mg/kg/day	3.06E-01
			Exp. Route Total								1.00E-04					3.75E-01
			Dermal	Aldrin	0.10	µg/L	NA	mg/kg/day	1.70E+01	1/mg/kg/day	NA	NA	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.71	µg/L	1.65E-07	mg/kg/day	1.60E+01	1/mg/kg/day	2.64E-06	4.62E-07	mg/kg/day	5.0E-05	mg/kg/day	9.24E-03
			Exp. Route Total								2.64E-06					9.24E-03
		Exposure Point Total									1.03E-04					3.85E-01
	Exposure Medium Total										1.03E-04					3.85E-01
Groundwater Total											1.03E-04					3.85E-01
											Total of Receptor Risks Across Soils and Groundwater					
											1.23E-04	Total of Receptor Hazards Across All Media				4.61E-01

NA = Not applicable.

RAGS Part D TABLE 7-7

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Shallow Soil	Shallow Soil (>6 inch - 2 ft bgs)	Ingestion	Aldrin	0.58	mg/kg	2.57E-08	mg/kg/day	1.70E+01	1/mg/kg/day	4.37E-07	5.00E-07	mg/kg/day	3.0E-05	mg/kg/day	1.67E-02
				Dieldrin	2.46	mg/kg	1.08E-07	mg/kg/day	1.60E+01	1/mg/kg/day	1.74E-06	2.11E-06	mg/kg/day	5.0E-05	mg/kg/day	4.22E-02
			Exp. Route Total								2.17E-06					5.88E-02
			Dermal	Aldrin	0.58	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	2.46	mg/kg	4.58E-08	mg/kg/day	1.60E+01	1/mg/kg/day	7.33E-07	3.56E-07	mg/kg/day	5.0E-05	mg/kg/day	7.12E-03
			Exp. Route Total								7.33E-07					7.12E-03
		Exposure Point Total									2.90E-06					6.60E-02
	Exposure Medium Total										2.90E-06					6.60E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.58	mg/kg	3.81E-09	mg/m^3	4.90E+00	$1/mg/m^3$	1.87E-08	2.96E-08	mg/m^3	NA	mg/m^3	NA
				Dieldrin	2.46	mg/kg	4.87E-13	mg/m^3	4.60E+00	$1/mg/m^3$	2.24E-12	3.79E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								1.87E-08					0.00E+00
		Exposure Point Total									1.87E-08					0.00E+00
	Exposure Medium Total										1.87E-08					0.00E+00
Soil Total											2.92E-06					6.60E-02
Total of Receptor Risks Across Soils and Groundwater											2.92E-06	Total of Receptor Hazards Across All Media				6.60E-02

NA = Not applicable.

RAGS Part D TABLE 7-8

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Shallow Soil	Shallow Soil (>6 inch - 2 ft bgs)	Ingestion	Aldrin	0.58	mg/kg						7.00E-07	mg/kg/day	3.0E-05	mg/kg/day	2.33E-02
				Dieldrin	2.46	mg/kg						2.95E-06	mg/kg/day	5.0E-05	mg/kg/day	5.90E-02
			Exp. Route Total								---					8.24E-02
			Dermal	Aldrin	0.58	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	2.46	mg/kg						1.25E-06	mg/kg/day	5.0E-05	mg/kg/day	2.49E-02
			Exp. Route Total								---					2.49E-02
		Exposure Point Total									---					1.07E-01
	Exposure Medium Total										---					1.07E-01
	Particulates/Vapors	Air	Inhalation	Aldrin	0.58	mg/kg						3.98E-11	mg/m^3	NA	mg/m^3	NA
				Dieldrin	2.46	mg/kg						3.98E-11	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.07E-01
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						2.93E-06	mg/kg/day	3.0E-05	mg/kg/day	9.78E-02
				Dieldrin	0.71	µg/L						2.14E-05	mg/kg/day	5.0E-05	mg/kg/day	4.28E-01
			Exp. Route Total								---					5.26E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						3.86E-05	mg/kg/day	5.0E-05	mg/kg/day	7.72E-01
			Exp. Route Total								---					7.72E-01
		Exposure Point Total									---					1.30E+00
	Exposure Medium Total										---					1.30E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					1.30E+00
Groundwater Total											---					1.30E+00
											Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media 1.41E+00

NA = Not applicable.

RAGS Part D TABLE 7-9

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Shallow Soil	Shallow Soil (>6 inch - 2 ft bgs)	Ingestion	Aldrin	0.58	mg/kg						7.47E-06	mg/kg/day	3.0E-05	mg/kg/day	2.49E-01
				Dieldrin	2.46	mg/kg						3.15E-05	mg/kg/day	5.0E-05	mg/kg/day	6.30E-01
			Exp. Route Total								---					8.79E-01
			Dermal	Aldrin	0.58	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	2.46	mg/kg						7.47E-06	mg/kg/day	5.0E-05	mg/kg/day	1.49E-01
			Exp. Route Total								---					1.49E-01
		Exposure Point Total									---					1.03E+00
	Exposure Medium Total										---					1.03E+00
	Particulates/Vapors	Air	Inhalation	Aldrin	0.58	mg/kg						3.98E-11	mg/m^3	NA	mg/m^3	NA
				Dieldrin	2.46	mg/kg						3.98E-11	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.03E+00
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						4.88E-06	mg/kg/day	3.0E-05	mg/kg/day	1.63E-01
				Dieldrin	0.71	µg/L						3.56E-05	mg/kg/day	5.0E-05	mg/kg/day	7.12E-01
			Exp. Route Total								---					8.75E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						5.82E-05	mg/kg/day	5.0E-05	mg/kg/day	1.16E+00
			Exp. Route Total								---					1.16E+00
		Exposure Point Total									---					2.04E+00
	Exposure Medium Total										---					2.04E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					2.04E+00
Groundwater Total											---					2.04E+00
											Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media 3.07E+00

NA = Not applicable.

RAGS Part D TABLE 7-10

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Age-Adjusted (Child/Adult)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Shallow Soil	Shallow Soil (>6 inch - 2 ft bgs)	Ingestion	Aldrin	0.58	mg/kg	8.40E-07	mg/kg/day	1.70E+01	NA	1.43E-05					
				Dieldrin	2.46	mg/kg	3.54E-06	mg/kg/day	1.60E+01	1/mg/kg/day	5.67E-05					
			Exp. Route Total								7.10E-05					---
			Dermal	Aldrin	0.58	mg/kg	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00					
				Dieldrin	2.46	mg/kg	9.97E-07	mg/kg/day	1.60E+01	1/mg/kg/day	1.59E-05					
			Exp. Route Total								1.59E-05					---
		Exposure Point Total									8.69E-05					---
	Exposure Medium Total										8.69E-05					---
	Particulates/Vapors	Air	Inhalation	Aldrin	0.58	mg/kg	1.16E-07	mg/m^3	4.90E+00	$1/mg/m^3$	5.66E-07					
				Dieldrin	2.46	mg/kg	1.48E-11	mg/m^3	4.60E+00	$1/mg/m^3$	6.80E-11					
			Exp. Route Total								5.66E-07					---
		Exposure Point Total									5.66E-07					---
	Exposure Medium Total										5.66E-07					---
Soil Total											8.75E-05					---
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	1.26E-06	mg/kg/day	1.70E+01	1/mg/kg/day	2.14E-05	---	---	---	---	---
				Dieldrin	0.71	µg/L	9.16E-06	mg/kg/day	1.60E+01	1/mg/kg/day	1.47E-04					
			Exp. Route Total								1.68E-04					---
			Dermal	Aldrin	0.10	µg/L	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00	---	---	---	---	---
				Dieldrin	0.71	µg/L	1.63E-05	mg/kg/day	1.60E+01	1/mg/kg/day	2.61E-04					
			Exp. Route Total								2.61E-04					---
		Exposure Point Total									4.29E-04					---
	Exposure Medium Total										4.29E-04					---
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L	1.74E-05	mg/m^3	4.90E+00	$1/mg/m^3$	8.54E-05					
				Dieldrin	0.71	µg/L		mg/m^3	4.60E+00	$1/mg/m^3$	0.00E+00					
			Exp. Route Total								8.54E-05					---
		Exposure Point Total									8.54E-05					---
	Exposure Medium Total										5.14E-04					---
Groundwater Total											5.14E-04					---
										Total of Receptor Risks Across Soils and Groundwater	6.01E-04	Total of Receptor Hazards Across All Media				---

NA = Not applicable.

RAGS Part D TABLE 7-11

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS for Site Worker Expsoure to Surface Soil

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Subsurface Soil (> 2 ft bgs)	Ingestion	Aldrin	0.03	mg/kg	9.26E-09	mg/kg/day	1.70E+01	1/mg/kg/day	1.57E-07	2.59E-08	mg/kg/day	3.0E-05	mg/kg/day	8.64E-04
				Dieldrin	0.49	mg/kg	1.50E-07	mg/kg/day	1.60E+01	1/mg/kg/day	2.39E-06	4.19E-07	mg/kg/day	5.0E-05	mg/kg/day	8.38E-03
			Exp. Route Total								2.55E-06					9.24E-03
			Dermal	Aldrin	0.03	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.49	mg/kg	6.33E-08	mg/kg/day	1.60E+01	1/mg/kg/day	1.01E-06	1.77E-07	mg/kg/day	5.0E-05	mg/kg/day	3.54E-03
			Exp. Route Total								1.0E-06					3.54E-03
		Exposure Point Total									3.56E-06					1.28E-02
	Exposure Medium Total										3.56E-06					1.28E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.03	mg/kg	1.37E-09	mg/m^3	4.90E+00	$1/mg/m^3$	6.72E-09	3.84E-09	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.49	mg/kg	6.72E-13	mg/m^3	4.60E+00	$1/mg/m^3$	3.09E-12	1.88E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								6.73E-09					0.00E+00
		Exposure Point Total									6.73E-09					0.00E+00
	Exposure Medium Total										6.73E-09					0.00E+00
Soil Total											3.57E-06					1.28E-02
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	7.48E-07	mg/kg/day	1.70E+01	1/mg/kg/day	1.27E-05	2.10E-06	mg/kg/day	3.0E-05	mg/kg/day	6.98E-02
				Dieldrin	0.71	µg/L	5.46E-06	mg/kg/day	1.60E+01	1/mg/kg/day	8.73E-05	1.53E-05	mg/kg/day	5.0E-05	mg/kg/day	3.06E-01
			Exp. Route Total								1.00E-04					3.75E-01
			Dermal	Aldrin	0.10	µg/L	NA	mg/kg/day	1.70E+01	1/mg/kg/day	NA	NA	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.71	µg/L	1.65E-07	mg/kg/day	1.60E+01	1/mg/kg/day	2.64E-06	4.62E-07	mg/kg/day	5.0E-05	mg/kg/day	9.24E-03
			Exp. Route Total								2.64E-06					9.24E-03
		Exposure Point Total									1.03E-04					3.85E-01
	Exposure Medium Total										1.03E-04					3.85E-01
Groundwater Total											1.03E-04					3.85E-01
										Total of Receptor Risks Across Soils and Groundwater	1.06E-04			Total of Receptor Hazards Across All Media		3.98E-01

NA = Not applicable.

RAGS Part D TABLE 7-12

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Current/Future
Receptor Population: Site Visitor
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Subsurface Soil (> 2 ft bgs)	Ingestion	Aldrin	0.03	mg/kg	1.33E-09	mg/kg/day	1.70E+01	1/mg/kg/day	2.27E-08	2.59E-08	mg/kg/day	3.0E-05	mg/kg/day	8.64E-04
				Dieldrin	0.49	mg/kg	2.15E-08	mg/kg/day	1.60E+01	1/mg/kg/day	3.45E-07	4.19E-07	mg/kg/day	5.0E-05	mg/kg/day	8.38E-03
			Exp. Route Total								3.67E-07					9.24E-03
			Dermal	Aldrin	0.03	mg/kg	0.00E+00	mg/kg/day	1.70E+01	1/mg/kg/day	0.00E+00	0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	NA
				Dieldrin	0.49	mg/kg	9.09E-09	mg/kg/day	1.60E+01	1/mg/kg/day	1.45E-07	7.07E-08	mg/kg/day	5.0E-05	mg/kg/day	1.41E-03
			Exp. Route Total								1.45E-07					1.41E-03
		Exposure Point Total									5.13E-07					1.07E-02
	Exposure Medium Total										5.13E-07					1.07E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.03	mg/kg	1.98E-10	mg/m^3	4.90E+00	$1/mg/m^3$	9.68E-10	1.54E-09	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.49	mg/kg	9.68E-14	mg/m^3	4.60E+00	$1/mg/m^3$	4.45E-13	7.53E-13	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								9.69E-10					0.00E+00
		Exposure Point Total									9.69E-10					0.00E+00
	Exposure Medium Total										9.69E-10					0.00E+00
Soil Total											5.14E-07					1.07E-02
Total of Receptor Risks Across Soils and Groundwater											5.14E-07	Total of Receptor Hazards Across All Media				1.07E-02

NA = Not applicable.

RAGS Part D TABLE 7-13

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Subsurface Soil (> 2 ft bgs)	Ingestion	Aldrin	0.03	mg/kg						3.63E-08	mg/kg/day	3.0E-05	mg/kg/day	1.21E-03
				Dieldrin	0.49	mg/kg						5.86E-07	mg/kg/day	5.0E-05	mg/kg/day	1.17E-02
			Exp. Route Total								---					1.29E-02
			Dermal	Aldrin	0.03	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.49	mg/kg						2.48E-07	mg/kg/day	5.0E-05	mg/kg/day	4.95E-03
			Exp. Route Total								---					4.95E-03
		Exposure Point Total									---					1.79E-02
	Exposure Medium Total										---					1.79E-02
	Particulates/Vapors	Air	Inhalation	Aldrin	0.03	mg/kg						7.91E-12	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.49	mg/kg						7.91E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.79E-02
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						2.93E-06	mg/kg/day	3.0E-05	mg/kg/day	9.78E-02
				Dieldrin	0.71	µg/L						2.14E-05	mg/kg/day	5.0E-05	mg/kg/day	4.28E-01
			Exp. Route Total								---					5.26E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						3.86E-05	mg/kg/day	5.0E-05	mg/kg/day	7.72E-01
			Exp. Route Total								---					7.72E-01
		Exposure Point Total									---					1.30E+00
	Exposure Medium Total										---					1.30E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					1.30E+00
Groundwater Total											---					1.30E+00
										Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media	1.32E+00

NA = Not applicable.

RAGS Part D TABLE 7-14

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Subsurface Soil (> 2 ft bgs)	Ingestion	Aldrin	0.03	mg/kg						3.87E-07	mg/kg/day	3.0E-05	mg/kg/day	1.29E-02
				Dieldrin	0.49	mg/kg						6.25E-06	mg/kg/day	5.0E-05	mg/kg/day	1.25E-01
			Exp. Route Total								---					1.38E-01
			Dermal	Aldrin	0.03	mg/kg						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.49	mg/kg						1.48E-06	mg/kg/day	5.0E-05	mg/kg/day	2.97E-02
			Exp. Route Total								---					2.97E-02
		Exposure Point Total									---					1.68E-01
	Exposure Medium Total										---					1.68E-01
	Particulates/Vapors	Air	Inhalation	Aldrin	0.03	mg/kg						7.91E-12	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.49	mg/kg						7.91E-12	mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					0.00E+00
Soil Total											---					1.68E-01
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L						4.88E-06	mg/kg/day	3.0E-05	mg/kg/day	1.63E-01
				Dieldrin	0.71	µg/L						3.56E-05	mg/kg/day	5.0E-05	mg/kg/day	7.12E-01
			Exp. Route Total								---					8.75E-01
			Dermal	Aldrin	0.10	µg/L						0.00E+00	mg/kg/day	3.0E-05	mg/kg/day	0.00E+00
				Dieldrin	0.71	µg/L						5.82E-05	mg/kg/day	5.0E-05	mg/kg/day	1.16E+00
			Exp. Route Total								---					1.16E+00
		Exposure Point Total									---					2.04E+00
	Exposure Medium Total										---					2.04E+00
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L						4.69E-05	mg/m^3	NA	mg/m^3	NA
				Dieldrin	0.71	µg/L							mg/m^3	NA	mg/m^3	NA
			Exp. Route Total								---					0.00E+00
		Exposure Point Total									---					0.00E+00
	Exposure Medium Total										---					2.04E+00
Groundwater Total											---					2.04E+00
											Total of Receptor Risk Across All Media					Total of Receptor Hazards Across All Media 2.21E+00

NA = Not applicable.

RAGS Part D TABLE 7-15

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Human Health Risk Assessment

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Age-Adjusted (Child/Adult)

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil	Subsurface Soil	Subsurface Soil (> 2 ft bgs)	Ingestion	Aldrin	0.03	mg/kg	4.36E-08	mg/kg/day	1.70E+01	NA	7.41E-07					
				Dieldrin	0.49	mg/kg	7.04E-07	mg/kg/day	1.60E+01	1/mg/kg/day	1.13E-05					
			Exp. Route Total								1.20E-05					---
			Dermal	Aldrin	0.03	mg/kg	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00					
				Dieldrin	0.49	mg/kg	1.98E-07	mg/kg/day	1.60E+01	1/mg/kg/day	3.17E-06					
			Exp. Route Total								3.17E-06					---
		Exposure Point Total									1.52E-05					---
	Exposure Medium Total										1.52E-05					---
	Particulates/Vapors	Air	Inhalation	Aldrin	0.03	mg/kg	5.99E-09	mg/m^3	4.90E+00	$1/mg/m^3$	2.94E-08					
				Dieldrin	0.49	mg/kg	2.94E-12	mg/m^3	4.60E+00	$1/mg/m^3$	1.35E-11					
			Exp. Route Total								2.94E-08					---
		Exposure Point Total									2.94E-08					---
	Exposure Medium Total										2.94E-08					---
Soil Total											1.52E-05					---
Groundwater	Groundwater	Tap water	Ingestion	Aldrin	0.10	µg/L	1.26E-06	mg/kg/day	1.70E+01	1/mg/kg/day	2.14E-05	---	---	---	---	---
				Dieldrin	0.71	µg/L	9.16E-06	mg/kg/day	1.60E+01	1/mg/kg/day	1.47E-04					
			Exp. Route Total								1.68E-04					---
			Dermal	Aldrin	0.10	µg/L	0.00E+00	mg/kg/day	1.70E+01	NA	0.00E+00	---	---	---	---	---
				Dieldrin	0.71	µg/L	1.63E-05	mg/kg/day	1.60E+01	1/mg/kg/day	2.61E-04					
			Exp. Route Total								2.61E-04					---
		Exposure Point Total									4.29E-04					---
	Exposure Medium Total										4.29E-04					---
	Air	Water Vapors from Showerhead	Inhalation	Aldrin	0.10	µg/L	1.74E-05	mg/m^3	4.90E+00	$1/mg/m^3$	8.54E-05					
				Dieldrin	0.71	µg/L		mg/m^3	4.60E+00	$1/mg/m^3$	0.00E+00					
			Exp. Route Total								8.54E-05					---
		Exposure Point Total									8.54E-05					---
	Exposure Medium Total										5.14E-04					---
Groundwater Total											5.14E-04					---
											Total of Receptor Risks Across Soils and Groundwater	5.29E-04		Total of Receptor Hazards Across All Media		---

NA = Not applicable.

APPENDIX B
ECOLOGICAL RISK ASSESSMENT TABLES

Table 6-1
Soil Ecological Screening Values

	Selected Screening Value (mg/kg)	Soil Invertebrates (mg/kg)		Plants (mg/kg)		Avian (mg/kg)		Mammalian (mg/kg)	
Aldrin	0.037	0.048	a	0.0332	b	NA		0.037	c
Dieldrin	0.0049	0.1	a	10	c	0.021	d	0.0049	d

Notes:

a - USEPA (2015) Region 4

b - USEPA (2003) Region 5 ESL

c - Los Alamos National Laboratory (LANL). 2015. ECORISK Database Release 3.3.

d - EPA, 2007

Table 6-2
Screening Level Risk Characterization

Detected Chemical	Frequency of Detection	Range of Detection Limits (ug/kg)	Range of Detected Concentrations (ug/kg)		Location of Maximum Detected Concentration	Ecological Screening Value [a] ug/kg		Avian Maximum Hazard Quotient (HQ)	Avian Frequency Exceeding ESV	Mammalian Maximum Hazard Quotient (HQ)	Mammalian Frequency Exceeding ESV
			Minimum	Maximum		Avian[b]	Mammalian				
					0-6" bgs						
Pesticides (mg/kg)											
Aldrin	12/52	0.47-33	1.5	400	SS-24	22	37	18	5/52	11	4/52
Dieldrin	24/52	0.29-0.77	0.76	2400	SS-24	22	4.9	109	16/52	490	19/52
					>6 inch bgs - 3 ft bgs						
Pesticides (mg/kg)											
Aldrin	5/16	0.51-6.1	16	584	FB-GCP-SB01-SL-3.0	22	37	27	4/52	16	4/52
Dieldrin	7/16	0.61-7.4	0.65	2600	SS3-2 (2')	22	4.9	118	5/52	531	6/52

a - USEPA Ecological Soil Screening Level (avian/mammalian), April 2007
b - Avian ESV not available for Aldrin; ESV for Dieldrin used as surrogate constituent
Footnotes:
*Table does not include subsurface concentrations greater than 3 ft bgs
PCOPEC - Preliminary chemicals of potential concern

Table 6-3
HQ Screening Analyses Avian Species

Detected Chemical	95% UCL (ug/kg)	Avian No Effect Ecological Screening Level [a] ug/kg					Avian Maximum Hazard Quotients (HQ)				
		Intermediate Carnivore	Top carnivore	Herbivore	Insectivore	Omnivore	Intermediate Carnivore	Top carnivore	Herbivore	Insectivore	Omnivore
0-6" bgs											
Pesticides (mg/kg)											
Aldrin	53.15	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	475.9	64	1500	350	12	23	7.4	0.32	1.4	40	21
>6 inch bgs - 3 ft bgs											
Pesticides (mg/kg)											
Aldrin	527.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	2495	64	1500	350	12	23	39	1.7	7.1	208	108

a - LANL (2015) ECORISK Database Release 3.3
Footnotes:
*Table does not include subsurface concentrations greater than 3 ft bgs
NA - ESLs not available for species

Table 6-4
HQ Screening Analyses Mammal Species

Detected Chemical	95% UCL (ug/kg)	Mammal No Effect Ecological Screening Level [a] ug/kg				Mammal Maximum Hazard Quotients (HQ)			
		Omnivore	Herbivore	Insectivore	Top Carnivore	Omnivore	Herbivore	Insectivore	Top Carnivore
0-6" bgs									
Pesticides (mg/kg)									
Aldrin	53.15	75	12000	37	10000	0.71	0.00	1.44	0.01
Dieldrin	475.9	8.8	300	4.5	930	54	1.6	106	0.51
>6 inch bgs - 3 ft bgs									
Pesticides (mg/kg)									
Aldrin	527.5	75	12000	37	10000	7.0	0.04	14	0.05
Dieldrin	2495	8.8	300	4.5	930	284	8.3	554	2.7

a - LANL (2015) ECORISK Database Release 3.3
Footnotes:
*Table does not include subsurface concentrations greater than 3 ft bgs
NA - ESLs not available for species

Table 6-5
HQ Screening Analyses Low Effects Level - Avian Species

Detected Chemical	Arithmetic Mean (ug/kg)	Avian Low Effect Ecological Screening Level [a] ug/kg					Avian Maximum Hazard Quotients (HQ)				
		Intermediate Carnivore	Top carnivore	Herbivore	Insectivore	Omnivore	Intermediate Carnivore	Top carnivore	Herbivore	Insectivore	Omnivore
					0-6" bgs						
Pesticides (mg/kg)											
Aldrin	18.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	134.93	3400	83000	18000	640	1200	0.04	0.002	0.01	0.21	0.11
					>6 inch bgs - 3 ft bgs						
Pesticides (mg/kg)											
Aldrin	81.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dieldrin	420.57	3400	83000	18000	640	1200	0.12	0.01	0.02	0.66	0.35

a - LANL ECORISK Databse Release 3.3
Footnotes:
*Table does not include subsurface concentrations greater than 3 ft bgs
NA - ESLs not available for species and HQ was not calculated

Table 6-6
HQ Screening Analyses Low Effects Level - Mammal Species

Detected Chemical	Arithmetic Mean (ug/kg)	Mammal Low Effect Ecological Screening Level [a] ug/kg				Mammal Maximum Hazard Quotients (HQ)			
		Omnivore	Herbivore	Insectivore	Top Carnivore	Omnivore	Herbivore	Insectivore	Top Carnivore
				0-6" bgs					
Pesticides (mg/kg)									
Aldrin	18.01	75	12000	37	10000	0.24	0.002	0.49	0.002
Dieldrin	134.93	8.8	300	4.5	930	15	0.45	30	0.15
				>6 inch bgs - 3 ft bgs					
Pesticides (mg/kg)									
Aldrin	81.66	75	12000	37	10000	1.1	0.01	2.2	0.01
Dieldrin	420.57	8.8	300	4.5	930	48	1.4	93	0.45

a - LANL (2015) ECORISK Database Release 3.3
Footnotes:
*Table does not include subsurface concentrations greater than 3 ft bgs
NA - ESLs not available for species

APPENDIX C
COST ESTIMATE

Appendix C – Cost Estimate
Cost Summary, All Alternatives
CCFTBR-H Site
Fort Liberty, NC

Alternative	Duration, years	Total Present Value of Capital Costs	Total Present Value of Annual Costs	Total Present Value of Periodic Costs	Total Present Value of Alternative
Alternative 1: No Action	N/A	$ -	$ -	$ -	$ -
Alternative 2: IC and Groundwater LTM	30	$ 119,981	$ 1,021,330	$ -	**$ 1,141,311**
Alternative 3: Soil Excavation, Offsite Disposal, and Groundwater LTM	30	$ 246,370	$ 379,773	$ -	**$ 626,144**
Alternative 4: Soil Excavation, Offsite Disposal, and Groundwater Treatment, and Groundwater Monitoring	10	$ 514,943	$ 237,753	$ -	**$ 752,696**

Notes:
IC = Institutional Controls
LTM = Long Term Monitoring
N/A = Not Applicable

Appendix C – Cost Estimate
Assumptions for All Alternatives
CCFTBR-H Site
Fort Liberty, NC

Alternative 1: No Action

- No remedial actions would occur at the CCFTBR-H site.

Alternative 2: IC and Groundwater LTM

Assumptions for IC:

- For cost estimating purposes, ICs were assumed for a duration of 30 years.
- For each year, it is assumed that notification letters will be sent out as well as annual inspections of the Site.
- Land use will be limited to commercial and industrial use.
- Signs will be posted around the site to deter trespassing from the public.

Assumptions for Groundwater LTM:

- An additional 4 monitoring wells would be installed downgradient of the plume to provided delineation data. Wells will be installed with similar construction as the existing wells located on Site.
- Annual sampling will occur on site for a duration of 30 years.
    - 1 sample will be collected from each of the 8 monitoring wells.
    - Samples will be collected utilizing low flow sampling and analyzed for Pesticides with a Stage 2b data package.
    - It is assumed that it will only take 1 day of field work to complete the sampling event

Alternative 3: Soil Excavation, Offsite Disposal, and Groundwater LTM

Assumptions for Soil Excavation:

- A topographic survey would be conducted to identify depressions in the surface cover.
- Monitoring well, FTBRH-MW-01, is within the excavation area and would require abandonment and would be reinstalled with similar construction as the abandoned well.
- For estimating purposes, the excavation volume was assumed to be a maximum of 1,500 BCY with an average depth of 8 feet below ground surface (bgs)
- Confirmation sampling will occur and be analyzed for Pesticides.
- Backfill material will be hauled in from off-site.
- Re-seeding/Replacement vegetative cover is assumed to be performed after area is backfilled.

Assumptions for Offsite Disposal:

- The waste generated from the excavation will be treated as Non-Hazardous Solid Waste and will be hauled via truck to the nearest available RCRA Subtitle D landfill, for estimating purposes it was assumed a 30 miles distance (one-way) to disposal facility.
- The maximum volume of Bulk Solid Waste is 1,500 CY

Assumptions for Groundwater LTM:

- An additional 4 monitoring wells would be installed downgradient of the plume to provide delineation data. Wells will be installed with similar construction as the existing wells located on Site.
- Annual sampling will occur on site for a duration of 30 years.
    - 1 sample will be collected from each of the 8 monitoring wells.
    - Samples will be collected utilizing low flow sampling and analyzed for Pesticides with a Stage 2b data package.

It is assumed that it will only take 1 day of field work to complete the sampling event

Alternative 4: Soil Excavation, Offsite Disposal, and Groundwater Treatment, and Groundwater Monitoring

Assumptions for Soil Excavation:

- A topographic survey would be conducted to identify depressions in the surface cover.
- Monitoring well, FTBRH-MW-01, is within the excavation area and would require abandonment and would be reinstalled with similar construction as the abandoned well.
- For estimating purposes, the excavation volume was assumed to be a maximum of 1,500 BCY with an average depth of 8 feet below ground surface (bgs).
- Confirmation sampling will occur and be analyzed for Pesticides.
- Backfill material will be hauled in from off-site.
- Re-seeding/Replacement vegetative cover is assumed to be preformed after area is backfilled.

Assumptions for Offsite Disposal:

- The waste generated from the excavation will be treated as Non-Hazardous Solid Waste and will be hauled via truck to the nearest available RCRA Subtitle D landfill, for estimating purposes it was assumed a 30 miles distance (one-way) to disposal facility.
- The maximum volume of Bulk Solid Waste is 1,500 CY.

Assumptions for Groundwater Treatment:

- An additional 4 monitoring wells would be installed downgradient of the plume to provided delineation data. Wells will be installed with similar construction as the existing wells located on Site.
- The Groundwater Treatment Approach would utilize Chemical Reduction.
- A Geophysical Utility Survey would need to be conducted prior to the treatment injections.

- Treatment dimensions were assumed to be a Length of 90 Liner Feet (LF), Width of 60 LF and a Thickness of 9 LF
- Treatment would be applied utilizing Direct Push Injection to all 8 wells on site.
- Treatment would be applied in one event with a total reagent volume of 2,916 gallons per event.

Assumptions for Groundwater Monitoring:

- For the first year, quarterly sampling will occur.
    - 1 sample will be collected from each of the 8 monitoring wells.
    - Samples will be collected utilizing low flow sampling and analyzed for Pesticides with a Stage 2b data package.
    - It is assumed that it will only take 1 day of field work to complete the sampling event.
- For the next 9 years, annual sampling will occur.
    - 1 sample will be collected from each of the 8 monitoring wells.
    - Samples will be collected utilizing low flow sampling and analyzed for Pesticides with a Stage 2b data package.
    - It is assumed that it will only take 1 day of field work to complete the sampling event.
- Five Year Reviews
    - 2 five-year reviews would be conducted during the 10-year monitoring period.

Appendix C – Cost Estimate
Alternative 2 – Present Value Analysis
CCFTBR-H Site
Fort Liberty, NC

Alternative 2: IC and Groundwater LTM							
Year	**Capital Costs**	**Present Value of Capital Costs**	**Annual Costs**	**Present Value of Annual Costs**	**Periodic Costs**	**Present Value of Periodic Costs**	**Cumulative Present Value**
0	$55,614	$55,335	$ -	$ -	$ -	$ -	$55,335
1	$64,970	$64,645	$ -	$ -	$ -	$ -	$64,645
2	$ -	$ -	$37,935	$37,745	$ -	$ -	$37,745
3	$ -	$ -	$37,935	$37,556	$ -	$ -	$37,556
4	$ -	$ -	$37,935	$37,368	$ -	$ -	$37,368
5	$ -	$ -	$37,935	$37,181	$ -	$ -	$37,181
6	$ -	$ -	$37,935	$36,996	$ -	$ -	$36,996
7	$ -	$ -	$37,935	$36,811	$ -	$ -	$36,811
8	$ -	$ -	$37,935	$36,627	$ -	$ -	$36,627
9	$ -	$ -	$37,935	$36,443	$ -	$ -	$36,443
10	$ -	$ -	$37,935	$36,261	$ -	$ -	$36,261
11	$ -	$ -	$37,935	$36,080	$ -	$ -	$36,080
12	$ -	$ -	$37,935	$35,899	$ -	$ -	$35,899
13	$ -	$ -	$37,935	$35,720	$ -	$ -	$35,720
14	$ -	$ -	$37,935	$35,541	$ -	$ -	$35,541
15	$ -	$ -	$37,935	$35,364	$ -	$ -	$35,364
16	$ -	$ -	$37,935	$35,187	$ -	$ -	$35,187
17	$ -	$ -	$37,935	$35,011	$ -	$ -	$35,011
18	$ -	$ -	$37,935	$34,836	$ -	$ -	$34,836
19	$ -	$ -	$37,935	$34,662	$ -	$ -	$34,662
20	$ -	$ -	$37,935	$34,488	$ -	$ -	$34,488
21	$ -	$ -	$37,935	$34,316	$ -	$ -	$34,316
22	$ -	$ -	$37,935	$34,144	$ -	$ -	$34,144
23	$ -	$ -	$37,935	$33,974	$ -	$ -	$33,974
24	$ -	$ -	$37,935	$33,804	$ -	$ -	$33,804
25	$ -	$ -	$37,935	$33,635	$ -	$ -	$33,635
26	$ -	$ -	$37,935	$33,467	$ -	$ -	$33,467
27	$ -	$ -	$37,935	$33,299	$ -	$ -	$33,299
28	$ -	$ -	$37,935	$33,133	$ -	$ -	$33,133
29	$ -	$ -	$25,816	$32,967	$ -	$ -	$32,967
30	$ -	$ -	$25,816	$32,802	$ -	$ -	$32,802
TOTAL	**$120,584**	**$119,980**		**$1,021,330**			**$1,141,311**

Present value costs were calculated following guidance under Appendix C of OMB Circular A-94.

Appendix C – Cost Estimate
Alternative 3 – Present Value Analysis
CCFTBR-H Site
Fort Liberty, NC

Alternative 3: Soil Excavation, Offsite Disposal, and Groundwater LTM							
Year	**Capital Costs**	**Present Value of Capital Costs**	**Annual Costs**	**Present Value of Annual Costs**	**Periodic Costs**	**Present Value of Periodic Costs**	**Cumulative Present Value**
0	$247,609	$246,370	$ -	$ -	$ -	$ -	$246,370
1	$ -	$ -	$13,669	$13,600	$ -	$ -	$13,600
2	$ -	$ -	$13,669	$13,532	$ -	$ -	$13,532
3	$ -	$ -	$13,669	$13,464	$ -	$ -	$13,464
4	$ -	$ -	$13,669	$13,397	$ -	$ -	$13,397
5	$ -	$ -	$13,669	$13,330	$ -	$ -	$13,330
6	$ -	$ -	$13,669	$13,264	$ -	$ -	$13,264
7	$ -	$ -	$13,669	$13,197	$ -	$ -	$13,197
8	$ -	$ -	$13,669	$13,131	$ -	$ -	$13,131
9	$ -	$ -	$13,669	$13,066	$ -	$ -	$13,066
10	$ -	$ -	$13,669	$13,000	$ -	$ -	$13,000
11	$ -	$ -	$13,669	$12,935	$ -	$ -	$12,935
12	$ -	$ -	$13,669	$12,871	$ -	$ -	$12,871
13	$ -	$ -	$13,669	$12,806	$ -	$ -	$12,806
14	$ -	$ -	$13,669	$12,742	$ -	$ -	$12,742
15	$ -	$ -	$13,669	$12,678	$ -	$ -	$12,678
16	$ -	$ -	$13,669	$12,615	$ -	$ -	$12,615
17	$ -	$ -	$13,669	$12,552	$ -	$ -	$12,552
18	$ -	$ -	$13,669	$12,489	$ -	$ -	$12,489
19	$ -	$ -	$13,669	$12,427	$ -	$ -	$12,427
20	$ -	$ -	$13,669	$12,365	$ -	$ -	$12,365
21	$ -	$ -	$13,669	$12,303	$ -	$ -	$12,303
22	$ -	$ -	$13,669	$12,241	$ -	$ -	$12,241
23	$ -	$ -	$13,669	$12,180	$ -	$ -	$12,180
24	$ -	$ -	$13,669	$12,119	$ -	$ -	$12,119
25	$ -	$ -	$13,669	$12,059	$ -	$ -	$12,059
26	$ -	$ -	$13,669	$11,998	$ -	$ -	$11,998
27	$ -	$ -	$13,669	$11,938	$ -	$ -	$11,938
28	$ -	$ -	$13,669	$11,879	$ -	$ -	$11,879
29	$ -	$ -	$13,669	$11,819	$ -	$ -	$11,819
30	$ -	$ -	$13,669	$11,760	$ -	$ -	$11,760
TOTAL	**$247,609**	**$246,370**		**$379,773**			**$626,114**

Present value costs were calculated following guidance under Appendix C of OMB Circular A-94.

Appendix C – Cost Estimate
Alternative 4 – Present Value Analysis
CCFTBR-H Site
Fort Liberty, NC

Alternative 4: Soil Excavation, Offsite Disposal, and Groundwater Treatment, and Groundwater Monitoring							
Year	**Capital Costs**	**Present Value of Capital Costs**	**Annual Costs**	**Present Value of Annual Costs**	**Periodic Costs**	**Present Value of Periodic Costs**	**Cumulative Present Value**
0	$514,943	$514,943	-	-	$ -	$ -	$514,943
1	-	-	$40,694	$40,694	$ -	$ -	$40,694
2	-	-	$23,412	$23,412	$ -	$ -	$23,412
3	-	-	$23,412	$23,412	$ -	$ -	$23,412
4	-	-	$23,412	$23,412	$ -	$ -	$23,412
5	-	-	$23,412	$23,412	$ -	$ -	$23,412
6	-	-	$23,412	$23,412	$ -	$ -	$23,412
7	-	-	$23,412	$23,412	$ -	$ -	$23,412
8	-	-	$23,412	$23,412	$ -	$ -	$23,412
9	-	-	$23,412	$23,412	$ -	$ -	$23,412
10	-	-	$9,763	$9,763	$ -	$ -	$9,763
TOTAL	**$514,943**	**$514,943**		**$237,753**	$ -	$ -	**$752,696**

Present value costs were calculated following guidance under Appendix C of OMB Circular A-94.

APPENDIX D
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND STANDARDS (ARARS)

Applicable or Relevant and Appropriate Requirements and Standards To Be Considered
CCFTBR-H, Fort Liberty, North Carolina

ARAR	Legal Citation	ARAR Class/TBC	Requirement Synopsis	Applicability to Proposed Remedies
Action-Specific ARARs/TBCs				
A. Water				
North Carolina Water Quality Standards	North Carolina Administrative Code, Title 15A, Subchapter 2L, Sections .0100, .0200, .0300 and .0400	Relevant and Appropriate	These provisions set the concentrations of pollutants that are allowable to levels that preserve human health based on water ingestion.	The established standards are being used to guide where groundwater treatment is required.
Discharge of Stormwater	North Carolina Administrative Code, Title 15A, Subchapter 2H, Section .0100	TBC	Requires the implementation of storm water control measures to minimize impact to surrounding properties and streams.	Storm water controls will be implemented to contain any sediment onsite during rain events during construction of the remedy.
North Carolina Well Abandonment Code	North Carolina Administrative Code, Title 15A, Subchapter 2C, Section .0113	Applicable	This code represents the requirements for proper abandonment of monitoring wells.	One or more monitoring wells will need to be abandoned to remove contaminated soils.
North Carolina Well Installation Code	North Carolina Administrative Code, Title 15A, Subchapter 2C, Section .0108.	Applicable	This code represents the requirements for proper installation of monitoring wells.	After excavation is completed, one or more monitoring wells will need to be installed to monitor groundwater. Temporary wells will also be needed to complete groundwater injections.
North Carolina Injection Well Code	North Carolina Administrative Code, Title 15A, Subchapter 2C, Sections .0225	Applicable	This code represents the process and requirements for the installation and operation of	Injections will be used at the site for groundwater remediation.

			injection wells for groundwater remediation.	
B. Soil				
Erosion and Sediment Controls	North Carolina Administrative Code, Title 15A, Chapter 4: Sediment Controls	Applicable	Identifies erosion and sediment control requirements and criteria for activities involving land clearing, grading, and other earth disturbances. Establishes erosion and sediment control criteria.	These regulations will apply to the excavation activities at the site that disturb the ground surface.
EPA Regional Screening Levels (RSLs)		TBC	U.S. EPA residential soil screening levels for residential and industrial uses. Soil to groundwater screening levels is also provided.	These screening levels are used as initial cleanup goals but are not de facto cleanup standards. These levels can be utilized to identify areas of contamination. If contaminant levels are below the screening level, no further action is necessary under CERCLA.
North Carolina Preliminary Soil Remediation Goals (PSRG)	NCDEQ Waste Management Program Guidance: Inactive Hazardous Sites Guidance Documents. PSRG Table (Jan. 2023)	Applicable	Identifies the levels to which soils should be removed for health or protection of groundwater.	Soils are being removed to primarily protect the health and secondarily minimize future contributions to the groundwater.
C. Wastes				
Hazardous Waste Management Regulations	North Carolina Administrative Code, Chapter 13, Subchapter A, Hazardous Waste Management	Applicable	Regulates the management of hazardous waste to ensure the safe and proper disposal of wastes and to provide for resource recovery by controlling	Establishes the general requirements for hazardous waste management.

			hazardous waste from “cradle to grave”.	
D. Air				
Fugitive Air Emissions	40 C.F.R § 50.6-50.7	Applicable	Establishes the fugitive dust regulation for particulate matter.	Any construction and/or excavation activities will comply with the substantive requirements of these regulations.
Control of Emissions from New and In-Use Nonroad Compression – Ignition Engines	40 C.F.R § 89 and 40 C.F.R § 1039	Applicable	Establishes emission requirements for nonroad diesel equipment from model year 1996 and newer.	Any construction equipment will comply with the emission Tier requirement applicable for its model year.