Final

Engineering Evaluation/Cost Analysis

December 2018
Version 00

Non-Time Critical Removal Action
Vault 4 and Trichloroethylene-Contaminated Sludge

Former Raco Army Airfield and Missile Site
Chippewa County, Michigan

Formerly Used Defense Sites Program Property No. E05MI0026
United States Army Corps of Engineers – Louisville District

Contract W912QR-12-D-0007 Delivery Order W912QR18F0390

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Bay West LLC has completed the Engineering Evaluation/Cost Analysis, Contract #W912QR-12-D-0007, Task Order W912QR18F0390, for Former Raco Army Airfield and Missile Site, Chippewa County, Michigan. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan. During the independent technical review, compliance with established policy principals and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in the analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

Peggy Churchill

12/05/18

Peggy Churchill, Independent Technical Reviewer — Date

12/03/18

Rick Van Allen, Senior Project Manager — Date

Significant concerns and explanation of the resolution are as follows:

None

As noted above, all concerns resulting from independent technical review of the project have been considered.

Table of Contents

EXECUTIVE SUMMARY **ES-1**
1.0 INTRODUCTION **1-1**
1.1 Authority and Intent 1-1
1.2 EE/CA Purpose and Stakeholders 1-2
2.0 SITE CHARACTERIZATION **2-1**
2.1 Site Description and Background 2-1
2.2 Physical Setting 2-1
2.2.1 Climate 2-1
2.2.2 Topography and Surface Drainage 2-1
2.2.3 Geology 2-2
2.2.4 Hydrogeology 2-2
2.2.5 Environmental Setting 2-2
2.3 Current and Future Use 2-3
2.3.1 Current Use 2-3
2.3.2 Water Use 2-3
2.3.3 Future Use 2-3
2.4 Previous Investigations 2-3
2.5 Contaminants of Concern and Impacted Media 2-5
2.6 Nature and Extent of Vault 4 Contaminated Materials 2-5
2.7 Streamlined Risk Evaluation 2-6
2.7.1 Fate and Transport 2-6
2.7.2 Exposure Pathways 2-6
2.7.3 Threats to Public Health and Welfare 2-7
2.7.4 Threats to the Environment 2-8
3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES **3-1**
3.1 Removal Action Objectives 3-1
3.2 Removal Action Scope 3-1
3.3 Applicable or Relevant and Appropriate Requirements 3-1
3.3.1 Applicable Requirements 3-2
3.3.2 Relevant and Appropriate Requirements 3-2
3.3.3 To Be Considered Criteria 3-2
3.3.4 ARARs and TBCs 3-3
3.4 Removal Action Schedule 3-4
4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES **4-1**
4.1 Alternative 1: No Action 4-1
4.2 Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4 4-1
4.3 Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal 4-2
5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES **5-1**
6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE **6-1**
7.0 INTERIM MONITORING **7-1**
8.0 REFERENCES **8-1**

List of Figures

Figure 1-1 Site Location Map
Figure 1-2 Site Map with Wastewater Treatment Area Detail
Figure 2-1 Regional Topography, Surface Water, and Wetlands
Figure 2-2 Land Use and Water Wells in the Vicinity of the Former Raco Site
Figure 2-3 Habitat Types Observed During the Ecological Reconnaissance

List of Tables

Table 3-1 ARARs and TBC 3-3
Table 3-2 Removal Action Schedule 3-4
Table 5-1 Comparative Evaluation Criteria and Results 5-1

List of Appendices

Appendix A Removal Action Approval Memorandum
Appendix B Field Summary Report
Appendix C Cost Estimate Summary

Acronyms and Abbreviations

§ ..... section
µg/kg..... micrograms per kilogram
°C ..... Degrees Celsius
amsl..... above mean sea level
ARARs..... applicable or relevant and appropriate requirements
Bay West ..... Bay West LLC
bgs..... below ground surface
CERCLA..... Comprehensive Environmental Response, Compensation, and Liability Act
CFR..... Code of Federal Regulations
COC ..... contaminant of concern
DCE..... dichloroethene
DERP ..... Defense Environmental Restoration Program
DoD ..... Department of Defense
EE/CA..... Engineering Evaluation/Cost Analysis
EO ..... Executive Order
FS..... Feasibility Study
ft ..... feet, foot
FUDS..... Formerly Used Defense Sites
GEO ..... GEO Consultants Corporation
GPS..... global positioning system
LDR ..... land disposal restriction
LUC ..... land use control
MCL..... maximum contaminant level
MDEQ..... Michigan Department of Environmental Quality
mg/kg..... milligrams per kilogram
mg/L ..... milligrams per liter
NCP..... National Oil and Hazardous Substances Pollution Contingency Plan
NTCRA ..... non-time critical removal action
O&M ..... operation and maintenance
OSWER ..... Office of Solid Waste and Emergency Response
PP..... Proposed Plan
PWS ..... Performance Work Statement
RAAM ..... Removal Action Approval Memorandum
RAO..... removal action objective
RAWP..... Removal Action Work Plan
RCRA ..... Resource Conservation and Recovery Act
RI..... Remedial Investigation
ROD..... Record of Decision
RSL..... regional screening level
Site ..... Former Raco Army Airfield and Missile Site
TBC ..... To Be Considered
TCE ..... trichloroethylene
TCLP ..... toxicity characteristic leaching procedure
UFP–QAPP.... Uniform Federal Policy for Quality Assurance Project Plan
USACE ..... U.S. Army Corps of Engineers
USC ..... United States Code
USDA..... U.S. Department of Agriculture
USEPA ..... U.S. Environmental Protection Agency
USFS ..... United States Forest Service
VC..... vinyl chloride
VOC..... volatile organic compound
VSB ..... vault soil boring

Executive Summary

The purpose of this Engineering Evaluation/Cost Analysis (EE/CA) is to evaluate alternatives for a non-time critical removal action (NTCRA) for Vault 4 and trichloroethylene (TCE)-contaminated sludge at the former Raco Army Airfield and Missile Site located in Chippewa County, Michigan. Work at this Site is being conducted by Bay West LLC (Bay West) under Contract Number W912QR-12-D-0007, Delivery Order W912QR18F0390 with the United States Army Corps of Engineers (USACE) – Louisville District.

Based on previous investigation activities, contamination is expected to be contained within Vault 4 and consists of TCE-contaminated sludge and soil. Previous investigation activities may have breached the interior structure of Vault 4 with potential downward vertical migration of TCE-contaminated soil and sludge within the vault resulting in a release or threatened release to the environment. The objective of the NTCRA is to address the risk of Vault 4 and its contents impacting soil and groundwater beneath Vault 4. Because the objective of the action is to address the vault and its contents, there will be no chemical specific applicable or relevant and appropriate requirements (ARARs) or to be considered (TBC) criteria.

The EE/CA evaluated the following alternatives to abate, prevent, minimize, stabilize, mitigate or eliminate a release or threatened release into the environment:

- Alternative 1: No Action;
- Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4; and
- Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal. Following removal, soil samples will be collected, and any residual contamination will be evaluated through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process pursuant to 5 C.F.R. § 300.415(g). If data gathered during the NTCRA require reconsideration of the Remedial Investigation/Feasibility Study (RI/FS) analysis and conclusions, those documents will be revisited as necessary

The three alternatives were evaluated using the alternative technology selection criteria established by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section (§) 300, for evaluating alternatives including effectiveness, implementability, and cost.

Based on the comparison of the effectiveness, implementability, and cost of the three alternatives, the recommended alternative is Alternative 3, Excavation of Vault 4 and TCE-contaminated Sludge with Off-Site Disposal. Alternative 3 meets the NTCRA objective for overall protection of human health and the environment. If contamination is limited to the interior cavity of Vault 4, no additional investigation under CERCLA would be required. Alternative 3 reduces the toxicity, mobility, and volume of contamination, is effective in the short- and long-term, and is implementable. The concrete vault is approximately 12 feet (ft) in diameter to a depth of 20 ft below ground surface (bgs), meaning approximately 61 tons of concrete and 104 tons of soil/sludge would need to be removed to achieve the NTCRA objective. The total estimated project cost for Alternative 3 is $147,290. The project is planned for funding by the USACE.

USACE is the decision maker and will select the final response alternative in coordination with USFS, as the entity with jurisdiction, custody and control of the Site, and MDEQ as the state regulator and support agency, after considering all comments received from stakeholders and the public during the public comment period. An Action Memorandum will be prepared to document the final removal action selection. The public will have an opportunity to review and comment on

this EE/CA, which describes the preferred removal action, prior to selection of the final response action in the Action Memorandum.

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared to evaluate a non-time critical removal action (NTCRA) for Vault 4 and trichloroethylene (TCE)-contaminated sludge at the former Raco Army Airfield and Missile Site (Site) located in Chippewa County, Michigan (**Figure 1-1**). Previous investigations have found TCE-contaminated sludge at high concentrations contained in a concrete structure identified as Vault 4 (**Figure 1-2**). This EE/CA assesses potential mitigation activities to eliminate the potential threat of a release of the TCE-contaminated sludge contained in Vault 4.

This EE/CA is being performed in accordance with the CERCLA (42 USCE §9601 et seq.) and the NCP (40 Code of Federal Regulations [CFR] 300.400). All activities were conducted in accordance with USACE, Department of the Army and Department of Defense requirements, regulations and procedures.

An EE/CA Approval Memorandum (referred to as Removal Action Approval Memorandum [RAAM]; **Appendix A**; USACE, 2018a) was prepared for the NTCRA. The RAAM served three important functions. First, the memorandum was used to secure management approval to conduct the EE/CA. Second, it documents that the situation meets the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria for initiating a removal action and that the proposed action is non-time-critical. Third, it provides detailed information pertaining to the Site background; threats to public health, welfare, or the environment posed by Vault 4 (e.g., expected changes in the situation if no action is taken or if the action is delayed); enforcement activities related to Vault 4; and projected costs. As authorized by the RAAM, the USACE is pursuing an NTCRA to mitigate the risks associated with the high TCE concentrations contained in Vault 4.

1.1 Authority and Intent

The Site is eligible for environmental restoration under the FUDS Program. All work must comply with the Defense Environmental Restoration Program (DERP) Statute (10 United States Code (USC) 2701 et seq.), the CERCLA (42 USC section [§] 9601 et seq., Executive Orders (EOs) 12580 and 13016, the NCP, and all applicable Department of Defense (DoD), Army and USACE regulations, policies, and guidance for the FUDS Program.

The DoD has the authority to undertake CERCLA response actions, including NTCRAs, under Title 42 of the USC § 9604, 10 USC § 2701, and EO 12580 and 13016. CERCLA Section 104(a) authorizes removal responses whenever:

- Any hazardous substance is released or there is a substantial threat of such a release into the environment; or
- There is a release or substantial threat of release into the environment of any pollutant or contaminant which may present an imminent and substantial danger to the public health or welfare.

The intent of this EE/CA is to identify the extent of the hazard, identify the objectives of the removal action and to analyze the various alternatives that may be used to satisfy these objectives for costs, effectiveness, and implementability. The selected removal action alternative must be protective of human health and the environment.

This EE/CA complies with the requirements of the Removal Action Procedures contained in 40 Code of Federal Regulations (CFR) 300.410 and 300.415, the Office of Solid Waste and Emergency Response (OSWER) Directive numbers 9318.0-05 and 9360.0-32 (USEPA, 1987 and 1993), and other related guidance.

1.2 EE/CA Purpose and Stakeholders

An EE/CA must be completed for all NTCRAs as required by section 300.415(b)(4)(i) of the NCP. The purpose of the EE/CA is to identify the objectives of the removal action and to analyze the various alternatives that may be used to satisfy these objectives for effectiveness, implementability, and cost. While an EE/CA is similar to the feasibility study (FS) conducted for remedial actions, it is streamlined. This EE/CA provides a strategy for the preferred NTCRA alternative, which includes removing Vault 4 and TCE-contaminated sludge for off-Site disposal at an approved facility.

Project stakeholders include agencies/parties that provide support of the EE/CA process and will review project documents to concur that actions are protective of human health and the environment. The lead organization is the USACE. The support agency is the Michigan Department of Environmental Quality (MDEQ). The public will have the opportunity to review and provide input on the EE/CA. The landowner is the United States. The U.S. Department of Agriculture Forest Service (USFS), has jurisdiction, custody, and control of the Site.

2.0 SITE CHARACTERIZATION

2.1 Site Description and Background

The Site is located 18 miles southwest of Sault Ste. Marie, Michigan, and entirely within the eastern portion of the Hiawatha National Forest. The Site consisted of 1,825.94 acres acquired between 1942 and 1945 via various transfer permits, licenses, leaseholds, easements, and fee purchases. Around 1960, the missile base was constructed southeast of the airfield. The DoD used the Site as an airfield for 21 years and as a missile base for about 13 years, ending in 1972. Between 1962 and 1964, the Air Force released all property interests to the USFS except for the 152.54-acre missile area and an additional 5-acre area. On 30 June 1973 and 24 March 1976, respectively, these 152.54-acre and 5-acre areas were released to the USFS. Since that time, the property has remained under USFS jurisdiction.

The Site historically consisted of a triangular-shaped airfield with 5,000 foot runways and a Bomarc Missile Site containing 28 missile launcher shelter mechanical/electrical pits and associated support facilities. With the exception of the runways and some associated tarmac/hardstands, the original structures have all been removed, and the launcher shelter mechanical/electrical pits have been filled in and covered. The airfield runways and other portions of the Site are currently used year-round for automobile tire testing by Smithers Scientific Services, Inc (Smithers). The remainder of the Site is vacant.

Vault 4 is located within the former wastewater treatment area of the former missile battery area (**Figure 1-2**). A historical drawing was used to identify the features of the wastewater treatment area shown on the inset on **Figure 1-2**, Vault 4 was identified as a 12-ft-by-8-ft settling tank. Investigation of Vault 4 indicates the dimensions are approximately 12 ft in diameter and 18 ft tall.

2.2 Physical Setting

The following sections describe the physical setting of the Site as presented in the Remedial Investigation (RI; USACE, 2018b).

2.2.1 Climate

The minimum, average, and maximum monthly temperatures in 2014–2015 were recorded from weather stations in the Raco, Michigan, area. In general, temperatures were below 0 degrees Celsius (°C) from November through April. Monthly precipitation amounts are highest in the late summer-early fall and lowest in the winter months. The cumulative yearly precipitation values for 2014 and 2015 were 23.33 and 19.92 inches, respectively, which were lower than the average annual precipitation of 33 inches.

The Upper Peninsula of Michigan receives a significant amount of snow. For example, Kincheloe, Michigan, located approximately 20 miles southeast of the Site, receives a mean annual snowfall of 124.1 inches (http://www.eldoradocountyweather.com/current/climate-noaa/Kincheloeclimate.html).

Temperatures generally stay below freezing in the winter months, accumulated snow likely melts from April-May. Water levels measured in April and July 2015 exhibit an increase of approximately 0.5 ft across all the monitoring wells at the missile battery area. This across the board increase is likely a result of recharge from melting snow.

2.2.2 Topography and Surface Drainage

The region surrounding the Site is an area of gently rolling terrain typical of a glaciated landscape. Topography is characterized by an elevated plateau to the west of the Site where surface elevations are between 900 and 1,000 ft above mean sea level (amsl). From the Site with an

elevation of approximately 900 ft amsl, the surface slopes to lower levels to the east and south. As the surface elevation decreases to a level of approximately 800 ft amsl and lower to the east, the landscape becomes an extensive wetland (**Figure 2-1**).

Figure 2-1 also illustrates the two main surface water systems in the region. To the north and east of the Site, streams form Waiska River that generally flows to the north and enters Lake Superior at the town of Brimley, Michigan approximately 12 miles to the east-northeast of the Site. Streams flowing south and southeasterly from the topographic plateau are tributaries that form Pine River, which flows in a southerly direction until it discharges into Lake Michigan approximately 20 miles south-southeast of the Site.

2.2.3 Geology

According to the RI, the Site is underlain by glacial outwash sediment and postglacial alluvium. These sand deposits, which can vary from fine to medium grain size material (with occasional coarse-grained lenses), were deposited at or very close to the shore of historical glacial Lake Algonquin that occupied the area of present day Lakes Michigan and Huron as well as part of Lake Superior. Soil boring data gathered during the investigations indicated that the dominant lithology is sand and generally transitions from very fine to fine grain size material in the western boreholes to more silty sand further to the east. Vault soil borings (VSB-02, VSB-05, VSB-08 [MW-26], VSB-09) within the Vault 4 area primarily encountered very fine to fine grained sand to their termination depths (87–127 ft below ground surface [bgs]).

According to the RI, bedrock beneath the glacial outwash sediments is the Black River Group Formation. The Black River and adjacent Trenton Groups are composed of dolomite and limestone, respectively (VerWeibe, 1927). The depth to bedrock in the Vault 4 area is estimated to be greater than 185 ft bgs.

2.2.4 Hydrogeology

According to the RI the regional water table for Chippewa County mimics the ground surface topography, corresponding to a depth of approximately 40 to 50 ft bgs. For example, water table elevations (greater than 860 ft amsl) are highest to the west of the Site, closely matching the area of high land surface elevation (900–1,000 ft amsl). In addition, the water table descends to the east and southeast of the Site to a minimum of approximately 700 ft amsl or lower in the north-south oriented valley occupied by the Waiska River and the Pine River drainage systems. The groundwater elevation is approximately 50 ft bgs (MW-26) in the vicinity of Vault 4.

2.2.5 Environmental Setting

An ecological reconnaissance was performed on August 29, 2014 at the beginning of the RI field work to determine whether there are significant ecological resources in the vicinity of the Site. The 23-acre area surveyed during the ecological reconnaissance encompassed the area surrounding the footprint of the TCE plume defined during the 2009 investigation (GEO Consultants Corporation [GEO], 2010). Three dominant habitat types were identified within the survey area: upland forest, old field and new field. Forest habitat is defined as a vegetative community dominated by woody vegetation greater than 20 ft tall. Old field habitat is defined as an herbaceous vegetative community dominated by woody vegetation coverage of less than 50 percent. New field habitat is an herbaceous vegetative community without woody vegetation. Common species of flora and fauna were noted; a detailed list can be found in the Ecological Assessment Report in the RI.

No wetlands, streams or open water areas are present in the study area. No federal or state-listed threatened or endangered species or critical habitat were identified during the ecological reconnaissance. RI did not reveal evidence of contaminated surface soil. Ecological receptor

exposure to groundwater is unlikely because the depth to the water table at the Site is 40–50 ft bgs.

2.3 Current and Future Use

2.3.1 Current Use

Current land use at the Site includes industrial, public forest, and limited residential use. The Site runways and the former missile battery area (including Vault 4) are operated under a Special Use Permit from USFS to Smithers and used for industrial purposes, i.e., vehicle winter testing. The surrounding area is managed by the USFS for the following uses: (1) to provide wildlife habitat for various avian species, (2) to provide conifer timber products to the regional economy, and (3) to provide dispersed and developed recreation (U.S. Department of Agriculture [USDA], 2006).

Because of its location within the National Forest System, the Site is likely to remain publicly owned and part of the Hiawatha National Forest in the future. There are privately owned recreation cabins in the National Forest that are on property managed by USFS although none are located within or around the Site. It is unlikely that such recreation residences will be constructed in the future because the USFS is no longer granting new permits for cabins/recreation residences in the Hiawatha National Forest (USDA, 2006). There are privately owned tracts of land within the Hiawatha National Forest, two of which are located approximately 1 mile east and 1.5 miles southeast of the Site, as shown in **Figure 2-2**. Several of the parcels within these tracts are vacant, and several parcels contain residences, with both year-round and partial-year occupancy.

2.3.2 Water Use

Based on data from the Michigan well database, there are no water supply wells in the privately-owned tract of land east of the Site. However, there are residential wells in the tract of land southeast of the Site. As part of the RI, these residential wells were sampled where granted permission by the well owners. No volatile organic compounds (VOCs) were detected in the water well samples.

Three water wells that supply drinking water to the Smithers buildings were sampled in 2009 and did not have detections of the contaminants of concern (COCs) (GEO, 2010). The water well that Smithers uses for automobile winter testing activities (i.e., to make snow or ice) was used as a drilling water source in 2014 and 2015. This well was sampled in 2009, 2014, and 2015 and none of the COCs were detected.

The areas with the highest density of public wells near the Site are at least 4–5 miles from the missile battery area. The areas include the city of Raco located 4–5 miles east northeast of the missile battery area, Brimley located more than 7 miles east/northeast, and Rudyard located more than 10 miles southeast (**Figure 2-2**). A small number of public wells are present near the Sullivan Creek Fish Hatchery located 3 miles south of the missile battery area and in the town of Fibre more than 5 miles southeast.

2.3.3 Future Use

Future land use at the Site is anticipated to be consistent with current use, industrial use (including Vault 4 area), public forest, and limited residential use.

2.4 Previous Investigations

An RI (USACE, 2018b) was completed to characterize the nature, extent, and risks posed by a TCE groundwater plume present at the Site. The RI included a source investigation in the wastewater treatment area of the former missile battery area to determine whether remnants of subsurface concrete wastewater treatment structures/vaults are still present and whether residual

materials in these vaults could be a source of the TCE groundwater plume. No removal actions have been conducted at the Site.

During the RI, potential locations of the wastewater treatment vaults were identified. The vaults were designated Vaults 1 through 5. In October 2016, test pits were excavated in the suspected locations of the vaults. Vault 1 was not found. Vaults 2 through 5 were found and investigated. Test pits were completed in and/or near the vaults. The excavated material was logged and where appropriate soil samples were collected and sent to an off-Site laboratory for VOC analysis. Based on the results of the October 2016 investigation, there was a question whether there was a potential active source of contamination in and around Vault 4. Evidence of a potential active source of contamination was not present in and around Vaults 2, 3, and 5.

During the RI no demolitions or removals were done below the ground surface at Vault 4. Vault 4 remained buried and partially uncovered. In September 2017, exploration of Vault 4 was continued with an excavator as part of a field program to gather additional information (GEO, 2017) and assess if the vault was an active source to the existing TCE groundwater plume. According to the Field Summary Report (**Appendix B**), the excavation extended to approximately 8 ft where, because of the inner chamber walls, it was no longer safe to continue removing material from inside the vault for concern of damaging the exterior and possibly causing a release. It was assumed that this was the top chamber of a multichambered vault; additional soil samples were collected from the northern and southern compartments and an aqueous sample was collected from the center compartment. The excavation continued along the outside of the Vault to determine the dimensions and condition of Vault 4. Vault 4 was determined to be approximately 18 ft tall and could not be completely excavated and removed with the equipment present. At that time, it was decided that Vault 4 would not be removed, but as much of the contents of the upper chamber would be removed as possible with the available equipment, and the drill rig would be used to attempt to collect deeper soil samples from within Vault 4. Based on the results of the excavation the vault is suspected to be an Imhoff Tank. No active leakages were observed; however, the bottom of Vault 4 was not exposed, and its condition remained unknown.

According to the RAAM (**Appendix A**), during the 2017 exploration of the Vault 4, an interior section of vault may have been breached, or partially breached, potentially causing migration of contaminated material into a lower section of the vault. Attachment 2 of **Appendix A** provides a photograph and field diagram of the potential breach.

The material that was removed from the upper portion of Vault 4 was placed in roll-off bins and the vault was backfilled with clean fill from above the tank while leaving the lip of the vault exposed for surveying. Upon the completion of field tasks, surfaces were smoothed and returned to their original shape as much as possible. The area was then seeded, fertilized, and covered in straw to restore the area to its state prior to the investigation. Photographs of Vault 4 excavation and restoration activities are included in **Appendix B**.

During the 2016 and 2017 exploration of the vaults, 31.33 tons of soil cuttings and excavation debris were generated and containerized. Samples were collected from the containerized material and analyzed for TCLP VOCs. Based on the TCLP sample results, the soil cuttings and excavation debris were characterized and disposed of as non-hazardous waste. During the 2017 investigation of Vault 4, soil borings were completed within and near Vault 4 (VSB-35, -39, and -42). One boring (VSB-42), completed in Vault 4, revealed a sludge material at approximately 13 feet below grade. Analytical results for this sludge sample collected inside Vault 4 indicated the presence of TCE at a concentration of 50 milligrams per kilogram (mg/kg). Soil samples collected

at boring VSB-35 outside of Vault 4 did not indicate the presence of TCE in samples collected at 17.5, 20, 22.5, and 25 feet below grade.

2.5 Contaminants of Concern and Impacted Media

TCE is the primary COC at Vault 4 along with its degradation products cis-1,2-dichloroethene (DCE), trans-1,2-DCE, and vinyl chloride (VC). Soil/sludge samples collected within Vault 4 showed evidence of TCE and cis-1,2-DCE. Soil and debris removed from Vault 4 also contained detectable concentrations of TCE.

No active leakages of Vault 4 were observed during the 2017 investigation. The analytical results are included in the Field Summary Report (**Appendix B**). These results include a table showing a comparison of the on-Site and off-Site soil sample results against regulatory criteria. Analytical data collected during the RI were compared to screening levels obtained from the following sources:

- USEPA Regional Screening Levels (RSLs) (USEPA, 2017, updated November)
- MDEQ Soil Screening Level for Protection of Residential Drinking Water, Part 201, Table 2, dated 12/30/2013
- Federal Safe Drinking Water Act-Maximum Contaminant Levels (MCLs) for 40 CFR 141, Subpart G.
- Toxicity Characteristic Leaching Procedure (TCLP), 40 CFR 261.24.

Analytical results for a sludge sample collected from boring VSB-42 within Vault 4 contained a TCE concentration of 50 milligrams per kilogram (mg/kg) which exceeds RSLs, and MDEQ Soil Screening Levels for Protection of Residential drinking water. The analytical results and screening criteria can be found in the Field Summary Report (**Appendix B)**.

2.6 Nature and Extent of Vault 4 Contaminated Materials

In 2017 Vault 4 was partially excavated, and upper portions of the concrete vault were removed. The contents of Vault 4 were sampled; however, the TCE-contaminated sludge remains in Vault 4. Following this investigative excavation work, Vault 4 was reburied and backfilled with soil. Currently, only the top of Vault 4 is visible at the ground surface. Based on the investigation data and conclusions of the RI, it is understood that the COCs in the sludge in Vault 4 are not actively contributing to the dissolved TCE groundwater plume and groundwater is not addressed in this EE/CA. Therefore, the nature and extent of groundwater contamination is not included in the Vault 4 discussion.

The location and aerial extent of Vault 4 is shown on **Figure 1-2**. In accordance with the Performance Work Statement (PWS) and for cost estimating purposes, the reinforced concrete vault is estimated to be 20 ft deep (18 ft tall) with a 12-ft diameter. The concrete walls are approximately 12 inches thick on the sides. The footing appears to be 2 ft wider than the diameter and an assumed 3 ft for footing depth. Vault 4 consists of multiple chambers separated by reinforced concrete. Approximately 61 tons of concrete and 104 tons of soil/sludge remains within Vault 4.

Elevated levels of TCE (up 50 mg/kg) are present in soil/sludge-like material remaining in Vault 4. There is evidence of natural degradation of TCE occurring within Vault 4 (cis-1,2-DCE, trans-1,2-DCE, and VC were detected within the vault). Except for samples collected from inside Vault 4, none of the soil samples collected adjacent to Vault 4 (boring VSB-35) exhibited COCs above screening criteria. There is currently no evidence that the contents of Vault 4 are leaking into the

surrounding soils, acting as an active source. However, no samples were collected directly beneath Vault 4. This represents a data gap.

TCE-contaminated sludge and soil remain inside Vault 4. Previous investigation and sampling activities may have damaged the interior structure of Vault 4 causing a release or threatened release of TCE-contaminated sludge to the environment. Vault 4 will continue to degrade with time and continued exposure to temperature extremes and precipitation infiltration increases the likelihood that a release to the environment may occur.

2.7 Streamlined Risk Evaluation

The RI conceptual Site exposure model shows potentially exposed populations, environmental media of concern, and exposure pathways. Although the maximum detected concentrations exceeded the screening levels in soils/sludges from Vault 4, a quantitative risk assessment was not performed for this medium because chronic direct exposure to soils in Vault 4 was considered unlikely for any of the Site receptors. The only VOC detections in soil at the Site are from the soil inside Vault 4, and soil near Vault 2 from the 2016 preliminary investigation that had a TCE level of <1 µg/kg. Therefore, only groundwater was carried forward in the RI to the quantitative risk assessment. This section summarizes potential future risks associated with potential release of the sludge (TCE 50 mg/kg) within Vault 4 to the environment.

2.7.1 Fate and Transport

The fate and transport of COCs are dependent on a wide variety of factors. Fate refers to the expected final state that an element, compound, or group of compounds will achieve following release to the environment. Transport refers to the mechanisms and rates of migration of contaminants away from the source area.

Analytical data for soil and groundwater outside but in the immediate vicinity of Vault 4 indicate that Vault 4 is not likely acting as a current source of the existing TCE groundwater plume at the Site. However, previous investigation activities may have breached the interior structure of Vault 4 potentially allowing for a release to the environment of the TCE-contaminated vault contents. In addition, the vault may deteriorate over time and release COCs to the soil and groundwater. If a removal action is not performed and a release of COCs from Vault 4 occurs, this could exacerbate the existing downgradient TCE groundwater plume. This could potentially reach private property owners with residential wells that are downgradient of the existing TCE groundwater plume.

2.7.2 Exposure Pathways

Current and future land use at the Site is industrial, public forest, and limited residential use. The missile battery area, including Vault 4, is leased by Smithers and used for industrial purposes, i.e., vehicle winter testing. The surrounding area is managed by the USFS for the following uses: (1) to provide wildlife habitat for various avian species, (2) to provide conifer timber products to the regional economy, and (3) to provide dispersed and developed recreation (USDA, 2006).

Potential exposure risks to humans is from workers performing intrusive activities that disturb the contents of the vault and potentially suspend dust-borne particles. Exposure pathways to human receptors could occur from dermal contact, ingestion, or inhalation. A direct exposure of Site receptors to the contents of Vault 4 is considered unlikely because Vault 4 was backfilled with clean fill after the 2017 investigation. However, there is a potential future risk to construction workers (i.e., workers performing intrusive activities), if development of the area occurs.

In the RAAM (**Appendix A**) USACE has stated that:

> "Based on the observations made during the investigation activities, Vault 4 contains TCE contaminated sludge. The TCE contaminated sludge within Vault 4 is currently isolated and

separate from the TCE groundwater plume at Raco. Vault 4 is understood to be structurally unsound presenting a risk of release of the TCE contaminated sludge into the underlying groundwater."

The risk of release of TCE contaminated sludge into the underlying groundwater presents a secondary risk to the receptors identified in the RI conceptual Site exposure model.

2.7.3 Threats to Public Health and Welfare

Five factors assessed under 40 CFR 300.415(b)(2) indicate there is a threat to human health and welfare posed by the contamination remaining in Vault 4, these factors as presented in the RAAM include:

> *Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release ((40 CFR 300.415(b)(2)(2)(iii)).*

TCE-contaminated soil/sludge is determined as a hazardous waste when its concentration exceeds the regulatory level identified in Table 1 – Maximum Concentration of Contaminants for Toxicity Characteristic (40 CFR 261.24). USEPA Hazardous Waste Number, D040, is TCE with a regulatory level of 0.5 milligrams per liter (mg/L). The analytical results presented in the 2017 Field Summary Report show that contaminant concentrations in soil/sludge inside Vault 4 are as high as 50 ppm for TCE. This is roughly 100 times the regulatory level. Based on professional judgment, this soil/sludge may be characteristically hazardous.

> *High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate ((40 CFR 300.415(b)(2)(2)(iv)).*

A source area investigation was performed near the wastewater treatment area in 2017 (GEO, 2017). Except for samples from inside Vault 4, none of the soil samples collected exhibited COCs above screening criteria. However, although there is no evidence that the sludge/soils within Vault 4 are currently affecting soils outside of Vault 4, in the RAAM (**Appendix A**) USACE has noted that:

"it is believed from the photos (Attachment 2) of the soil core columns (Appendix B; Figure 2. VSB39) and boring diagram that the contractor breached or partially breached a section of the interior concrete vault causing additional expansion/migration of contaminated sediments within the lower sections of the vault (see the "moist sand" below the concrete in the column profile). It is reasonable to assume that if the boring breached an interior, vertical concrete barrier, the contaminated sludge will be migrating downward into the dry sand. Furthermore, it is impossible to know whether the lower section of the exterior casing or the foundation have cracks through which contamination could be released into the exterior environment."

> *Weather conditions that may cause hazardous substances, pollutants or contaminants to migrate or be released ((40 CFR 300.415(b)(2)(2)(v)).*

Vault 4 is open to the environment with portions of exposed rebar and crushed concrete at the top of the structure. Vault 4 is not covered by any engineering barriers. In its present state it is likely that Vault 4 will continue to deteriorate as it continues to be exposed to conditions that occur at the Site and within the vault (i.e. microbial induced deterioration of concrete, freeze-thaw cycles and the continued expansion of rebar due to rust). Eventually, this is likely to cause a release of the TCE contaminated sludge within this structure.

> *Potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants ((40 CFR 300.415(b)(2)(2)(i)) and Potential contamination of drinking water supplies or sensitive ecosystems ((40 CFR 300.415(b)(2)(2)(ii)).*

Analytical data for soil and groundwater outside but in the immediate vicinity of Vault 4 indicate that Vault 4 is not likely acting as a current source of the existing TCE groundwater plume at Raco. The structural integrity of the vault is unknown. If a Removal Action is not performed and a TCE release from Vault 4 occurred, this will exacerbate the existing downgradient TCE groundwater plume. This could potentially reach private property owners with residential wells that are downgradient of the existing TCE groundwater plume.

Other situations or factors that may pose threats to public health or welfare of the United States or the environment ((40 CFR 300.415(b)(2)(2)((viii)).

The TCE groundwater plume at Raco is being addressed through the CERCLA remedial process, moving into the Feasibility Study (FS) phase. The final Proposed Plan (PP)/Decision Document (DD) is not anticipated to occur until Fiscal Year 2020. The state and condition of Vault 4 cannot be guaranteed as the project moves through the CERCLA remedial process. If a Removal Action is not performed and a TCE release from Vault 4 occurs, all sampling, migration and risk assumptions used in the CERCLA remedial process for the TCE groundwater plume will be invalidated. This will have major financial consequences as the Army would be obligated to conduct further costly investigations to reevaluate the TCE groundwater plume's stability and delineate the TCE groundwater plume further.

Factors Not Considered Applicable

Factors not considered to be applicable are in this memorandum are: Threat of fire or explosion ((40 CFR 300.415(b)(2)(2)(vi)). The contents of Vault 4 do not present any explosive hazards. The availability of other appropriate federal or state response mechanisms to respond to the release ((40 CFR 300.415(b)(2)(2)(vii)). No other response mechanisms exist at this time.

2.7.4 Threats to the Environment

Vault 4 is not covered by any engineering barriers. In its present state it is likely that Vault 4 will continue to deteriorate as it continues to be exposed to conditions that occur at the Site and within the vault (i.e. microbial induced deterioration of concrete, freeze thaw cycles and the continued expansion of rebar due to rust). Eventually, this is likely to cause a release of the TCE-contaminated sludge within this structure.

Previous investigations and fieldwork performed for this RI did not reveal surface contamination in exceedance of screening criteria. Contaminated soil/sludge-like material was only found in the buried remnants of Vault 4. TCE-contaminated groundwater is present at the Site, but the water table occurs 50 ft bgs. Based on Site conditions, direct exposure of ecological species to contaminated soil in Vault 4 and groundwater is considered unlikely. An ecological reconnaissance was performed in the vicinity of the missile battery area in August 2014, the results of which are detailed in the RI Report. No additional ecological site assessments or ecological risk assessments were recommended for this Site.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

3.1 Removal Action Objectives

Removal action objectives (RAOs) consist of goals for protecting human health and the environment and can be achieved by reducing exposure as well as by reducing contaminant levels. RAOs drive the formulation and development of response actions. RAOs are developed based on criteria outlined in Section 300. 430(e)(2) of the NCP and Section 121 of the Superfund Amendments and Reauthorization Act (SARA). RAOs should specify the contaminants of concern, exposure routes and receptors, and clean-up criteria. The following elements were used to develop the Vault 4 and TCE-contaminated sludge NTCRA RAOs:

- Contaminants of Concern: TCE, cis-1,2-DCE, trans-1,2-DCE, and VC.
- Exposure Routes and Receptors: Vertical migration of COCs from Vault 4 to groundwater and inhalation and dermal contact by current and future construction workers performing intrusive activities.
- Clean-up Criteria: No chemical specific clean up criteria were identified; however, visual confirmation of the removal of the concrete comprising Vault 4 and the visual confirmation of the removal of the material within Vault 4 will be documented.
- NTCRA Objective: Address risk posed by the vault and the material within.

Based on previous investigation activities, contamination is expected to be contained within Vault 4 and consists of TCE-contaminated sludge and soil. Previous investigation activities may have breached the interior structure of Vault 4 with potential downward vertical migration of TCE-contaminated soil and sludge within the vault resulting in a release or threatened release to the environment. The objective of the NTCRA is to address the risk of Vault 4 and its contents impacting soil and groundwater beneath Vault 4.

The following RAO will be achieved when the NTCRA is complete:

- To abate, prevent, minimize, stabilize, mitigate or eliminate potential future risks to human health and the environment from a release or threatened release of TCE impacted sludge to the soil or soil and groundwater for TCE and its daughter products.

3.2 Removal Action Scope

Based on the investigations performed to date, sludge within Vault 4 is impacted by TCE with concentrations greater than the USEPA Residential RSL for TCE that also possibly exceed the criteria for a characteristically hazardous waste. Vault 4 and TCE-contaminated sludge is present in an approximately 12-ft-diameter area to an estimated depth of 20 ft bgs. The weight of concrete and sludge is estimated to be 165 tons. The approximate area of Vault 4 is shown on **Figure 2-1**, which is the proposed removal area. The evaluated removal action and alternatives will mitigate the TCE impacted materials and reduce the likelihood of a release to the environment.

The NTCRA is intended to be a final action to mitigate TCE-impacted materials present in the Vault 4 area. This action has been designated as non-time critical because a 6-month planning period was available from the time an action was determined to be necessary to the time when the action would be initiated.

3.3 Applicable or Relevant and Appropriate Requirements

ARARs specifically address hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances found at a CERCLA site and are further defined below.

3.3.1 Applicable Requirements

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. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

3.3.2 Relevant and Appropriate Requirements

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 situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate.

3.3.3 To Be Considered Criteria

TBC criteria have also been evaluated. TBC criteria are proposed standards, advisories, and guidance developed by federal and state environmental and health programs that are not enforceable but provide helpful information for determining levels of protection and selecting removal technologies.

3.3.4 ARARs and TBCs

ARARs can be divided into location-specific, action-specific, and chemical-specific items. No ARARs were identified for this NTCRA. The TBC criteria identified for Vault 4 are provided in **Table 3-1**.

Table 3-1 ARARs and TBC

ARAR		
ARAR	**Citation**	**Applicable, Relevant and Appropriate**
Location-Specific		
None identified		
Action-Specific		
None identified.		
Chemical-Specific		
None identified.		
TBC		
TBC	**Citation**	**TBC**
Location-Specific		
Future Land Use	2006 Hiawatha Forest National Plan	Identification of Future Land Use, impacts of removal action on land use
Action-Specific		
None identified.		
Chemical-Specific		
None identified.		

3.4 Removal Action Schedule

The removal action schedule is contained in **Table 3-2**.

Table 3-2 Removal Action Schedule

Activities	2018					2019												2020
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
Draft EE/CA	X	●																
Draft Final EE/CA		X	X	X	●													
Public Comment Period					X	●												
Public Meeting					X ●													
Final EE/CA					X ●													
Draft Action Memorandum					X	●												
Draft Final Action Memorandum						X	●											
Final Action Memorandum							X	X	●									
Draft RAWP/UFP-QAPP									X	●								
Draft Final RAWP/UFP-QAPP										X	●							
Final RAWP/UFP-QAPP											X	●						
Removal Action												X	X	●				
Draft Field Summary Report														X	●			
Draft Final Field Summary Report															X	●		
Final Field Summary Report																X	X	●

Notes:

● = Activity Completion
X = Duration

4.0 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

In accordance with ER-200-3-1 (USACE, 2004) for a removal action, a limited number of alternatives are evaluated because removal actions generally have limited objectives, and typically are short-term actions to mitigate the threat posed by a release or threatened release of hazardous substances or pollutants or contaminants, thereby allowing completion of the removal action process. The following alternatives are to be considered as part of the EE/CA:

- A no action alternative that assumes a return to the remedial process to complete site characterization and to determine the need for additional remedial activities;
- An alternative that achieves identified removal action objectives without achieving full compliance with all ARARs.;
- An alternative that achieves identified removal action objectives while achieving full compliance with all ARARs.

Therefore, the following alternatives were developed and retained for comparative analysis:

- Alternative 1: No Action;
- Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4; and
- Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal.

4.1 Alternative 1: No Action

Alternative 1 involves no actions to be performed under current or future land use scenarios. No land use controls such as fencing, warning signs, or institutional controls are included in the No Action alternative. The No Action alternative would result in this area being investigated and addressed under the existing CERCLA remedial action pending at the property. The NCP considers the No Action alternative as a baseline for comparison with other alternatives.

4.2 Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4

Under Alternative 2, Vault 4 would be exposed using an excavator. TCE-contaminated soil/sludge would be removed from inside Vault 4 using a combination of excavation and vacuum truck and disposed of off-Site. Vault 4 would be left in-place and backfilled with acceptable material following removal of its contents. Activities would be performed with an excavator, hand excavation tools (e.g., shovels), and a vacuum truck. The TCE-contaminated sludge would be sampled for TCLP analysis prior to transport and off-Site disposal. The waste characterization samples of the sludge and soil would be collected as composites of the material staged on-Site in lined roll-off boxes. It is anticipated that the soil/sludge would be characterized as non-hazardous waste by the composite sampling methodology and would be disposed of in a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. If TCLP results determine that the soil/sludge is hazardous waste, it will be disposed of as a hazardous waste in a licensed hazardous waste disposal facility.

As discussed in **Section 2.6**, approximately 104 tons of soil/sludge would require excavation to achieve the RAO. The Vault 4 area is shown on **Figure 1-2**.

Once the excavation is complete, the condition of the vault bottom and sidewalls will be inspected for deterioration, including cracks and spalling. Sample locations and the final extent of the excavation would be surveyed using a hand-held global positioning system (GPS) unit with sub-meter precision. The excavation and vault would be backfilled with acceptable material. The area

would be seeded, fertilized, and covered in straw to restore the area to its state prior to the removal action.

Because there is a possibility that a release may have occurred through the bottom of the vault a risk for migration of COCs to soil and groundwater may be present. Therefore, once the TCE soil/sludge removal action is complete, additional investigation under CERCLA could be required as no confirmation samples would be collected to determine if a release occurred through the bottom of the vault. Land Use Controls may be necessary unless it could be confirmed that the remaining concrete and soil beneath the vault is not impacted with TCE.

4.3 Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal

Vault 4 and the TCE-contaminated soil/sludge would be removed and disposed of off-Site. Excavation activities would be performed with an excavator. The concrete and TCE-contaminated soil/sludge would be sampled and analyzed for TCLP prior to transport and off-Site disposal. The waste characterization samples of the sludge and soil would be collected as composites of the material staged on-Site in lined roll-off boxes. It is anticipated that the soil/sludge would be characterized as non-hazardous waste by the composite sampling methodology, and so would be disposed of in a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill. If TCLP results determine that the soil/sludge is hazardous waste, it will be disposed of as a hazardous waste in a licensed hazardous waste disposal facility.

As discussed in **Section 2.6**, an approximate 165 tons of concrete and soil/sludge would require excavation to an anticipated depth of 20 ft bgs to achieve the RAO. The approximate removal area is shown on **Figure 1-2**.

Once the excavation is complete, confirmation soil samples would be collected from the bottom and sidewalls of the excavation and submitted to a fixed-base laboratory for VOC analysis. Any residual contamination will be evaluated through the CERCLA process pursuant to 5 C.F.R. § 300.415(g). If data gathered during the NTCRA require reconsideration of the RI/FS analysis/conclusions, those documents will be revisited as necessary. Because the objective of this alternative is to remove the vault and its contents, there will be no chemical specific ARARs or TBCs. Soil sample locations and the final extent of the excavation would be surveyed using a hand-held GPS unit with sub-meter precision. The soil excavation area would be backfilled with acceptable material. The area would be seeded, fertilized, and covered in straw to restore the area following the removal action.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of the three alternatives described in **Section 4.0** using effectiveness, implementability, and cost and the nine evaluation criteria required by the NCP. The information presented in **Table 5-1** summarizes the relative advantages and disadvantages of each alternative for the purposes of identifying the best alternative to address Vault 4 and TCE-contaminated sludge/soil. A detailed cost estimate is included in **Appendix C**.

Table 5-1 Comparative Evaluation Criteria and Results

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4	Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal
	Advantage/Disadvantage	Advantage/Disadvantage	Advantage/Disadvantage
Effectiveness			
Overall Protection of Human Health and the Environment	Not protective to human receptor in the long term. No impacts to the environment were determined to be present.	Provides protection of human health and the environment.	Provides protection of human health and the environment. Meets RAOs.
Compliance with ARARs and Other Criteria	There are no ARARs.	There are no ARARs.	There are no ARARs.
Long-Term Effectiveness and Permanence	Not effective in reducing potential long-term exposure.	May not be effective in the long term; does not provide a permanent solution as TCE impacted concrete may remain, Vault 4 will continue to deteriorate, and potential TCE impacted soil may be present and remain beneath Vault 4.	Provides an effective long-term, permanent solution to eliminate potential exposures.
Short-Term Effectiveness	No remedial action involved; therefore, short-term effectiveness not applicable.	Ineffective. Removal of residual contaminated soil and sludge using hand tools and excavation equipment may risk vault collapse and cave-in with an unacceptable risk to worker safety.	Short-term measurements would be implemented to protect workers during the excavation and transportation activities.
Reduction of Toxicity, Mobility, or Volume	No reduction of toxicity, mobility, or volume.	Reduces mobility, toxicity, and volume of TCE impacted soil/sludge. Does not reduce mobility, toxicity, and volume of TCE impacted concrete and TCE-contaminated soil may remain below Vault 4.	Reduces mobility, toxicity, and volume of TCE impacted concrete and soil/sludge.

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4	Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal
	Advantage/Disadvantage	**Advantage/Disadvantage**	**Advantage/Disadvantage**
Implementability			
Implementability	No action proposed. Technically and administratively feasible.	Technically not feasible. The breach of the upper chambers of Vault 4 during previous investigation activities may have made access to the lowest portions of the vault and removal of all the contaminated soil and sludge impossible. Without removing Vault 4 entirely it is impossible to assess the integrity of the base of the vault and technically difficult to fully assess if a release of TCE-contaminated sludge or soil to the environment has occurred.	Technically/administratively feasible. Equipment and supplies are available.
Regulatory Acceptance[1]	Not anticipated to be accepted by Regulators.	May not be accepted by Regulators.	Anticipated to be accepted by Regulators.
Community Support[2]	Not anticipated to be supported.	May not be supported.	Anticipated to be supported.
Cost			
Capital Cost	$0	$118,720	$147,290
Annual O&M Costs	$0	$0	$0
Total Net-Present Value Cost	$0	$118,720	$147,290

Notes:
[1] Regulatory acceptance will be evaluated during the EE/CA review process. The advantage/disadvantage are the anticipated results at this time.
[2] Community support will be evaluated during the EE/CA public comment period. The advantage/disadvantage and ranking are the anticipated result at this time.
O&M - operation and maintenance

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

This EE/CA was developed in accordance with requirements under CERCLA as amended, and the NCP Section 300.415 for a NTCRA. A comparative analysis was performed to evaluate alternatives to mitigate hazards associated with Vault 4 and TCE-contaminated sludge. Alternative 3: Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal best achieves the NTCRA objective by meeting the criteria for protecting present and future human receptors from the COC. Alternative 3 would also achieve the RAOs. No additional investigation under CERCLA would be required, unless the underlying and/or adjacent soils are found to be impacted by COCs.

As this NTCRA moves forward and in conjunction with the Removal Action Work Plan (RAWP), it is recommended that the work elements are designed in accordance with requirements outlined in the following guidance documents to conduct the NTCRA actions in an environmentally beneficial way. Specific environmental considerations may include the recycling of debris, overall activities that result in the reduction of carbon dioxide emitted, the use of biodiesel, and comparisons of disposal locations to reduce fuel consumption and trucking distance. Environmental cost benefits to the removal action would be reported in the Field Summary Report following the completion of the NTCRA as outlined in this EE/CA. The referenced guidance documents include the following:

- Methodology for Understanding and Reducing a Project's Environmental Footprint, EPA 542-R-12-002 by the USEPA;
- Green Remediation: Best Management Practices for Excavation and Surface Restoration, EPA 542-F-08-012 by the USEPA;
- Section 4.0 Green, Sustainable Remediation of the Environmental Restoration Program Optimization Guidance, Revision 0.9 by the Air Force Center for Engineering and the Environment; and
- Final Report: Green Remediation at Federal Facility Cleanups by the Association of State and Territorial Solid Waste Management Officials.

At this time, it is recommended that Alternative 3 be approved to complete the proposed NTCRA. Upon final review and concurrence of the EE/CA by MDEQ, the EE/CA and Administrative Record will be made available to the public for review and comment. Following the public comment period, an Action Memorandum will be prepared to respond to significant comments received during the public comment period and to document the selected removal action and the proposed NTCRA activities prior to finalizing the Removal Action Work Plan.

7.0 INTERIM MONITORING

The preferred alternative selected in this EE/CA, Excavation of Vault 4 and TCE-Contaminated Sludge with Off-Site Disposal. It is anticipated that the preferred alternative would achieve the RAOs at the conclusion of the NTCRA and that no monitoring of the Vault 4 area would be required. This would be documented in the Field Summary Report.

If USACE determines that the removal action will not fully address the threat posed by the release and additional remedial action may be required, USACE will transition the removal action back to the existing remedial investigation in accordance with §300.415(g) of the NCP.

8.0 REFERENCES

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Figures

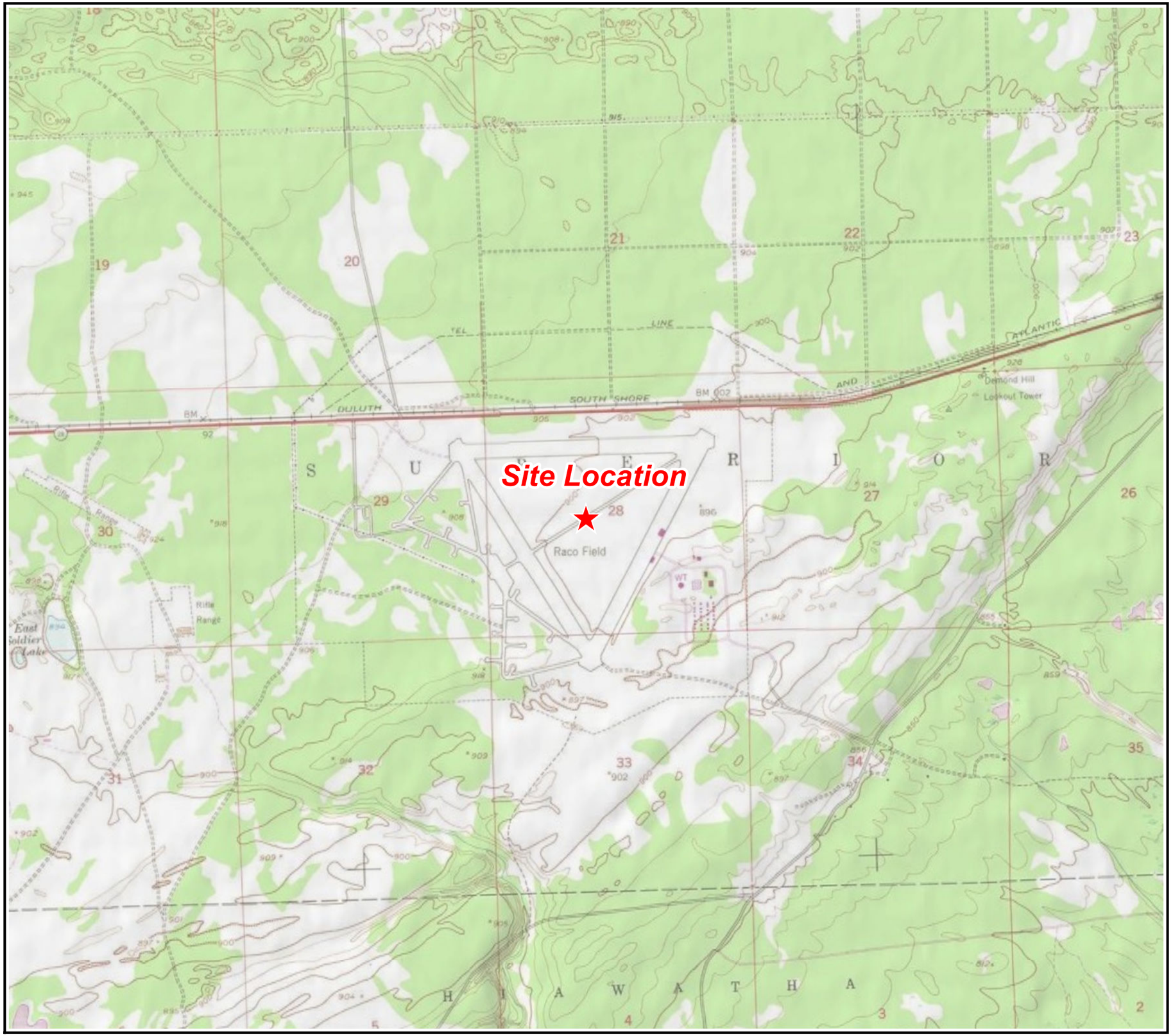
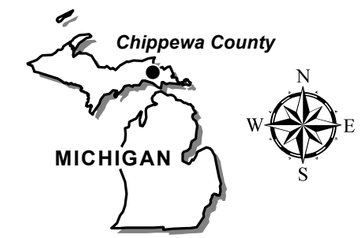


Figure 1-1

Site Location Map

RACO Army Airfield and Missile Site

Chippewa County, Michigan
U.S. Army Corps of Engineers
Louisville District



Map Projection: NAD 1983 State Plane Michigan North FIPS 2111
Basemap: National Geographic Society, i-cubed

0 2,000 4,000 Feet
0 600 1,200 Meters

1 inch = 2,000 feet

★ Site Location

Drawn By: N.J. Date Drawn/Revised:9/6/2018 Project No.J180557

Y:\Clients\US_ARMY_CORP_OF_ENGINEERS_LOUISVILLE\Raco_Army_Air_Field\MapDocs\180557\001_Updates\J180557 FIG 1-1 Site Location Map.mxd

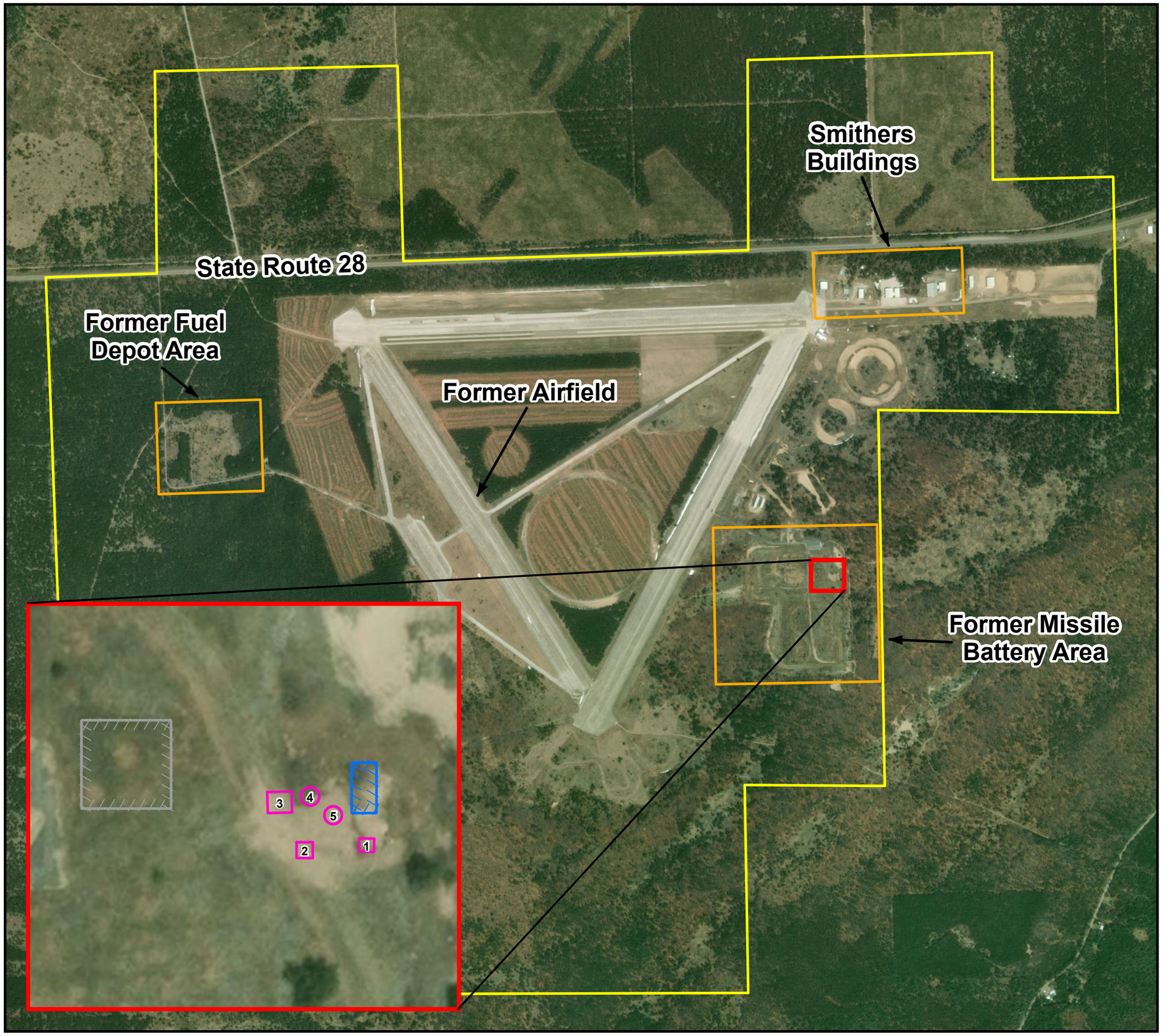
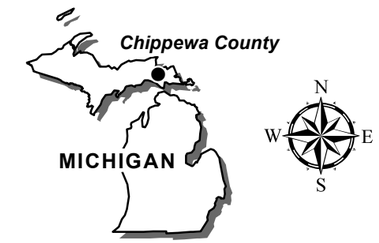


Figure 1-2

Site Map with Wastewater Treatment Area Detail

RACO Army Airfield and Missile Site

Chippewa County, Michigan
U.S. Army Corps of Engineers
Louisville District



Map Projection: NAD 1983 State Plane Michigan North FIPS 2111
Basemap: ESRI World Imagery WMS, 4/24/2017

0 1,000 2,000 3,000 Feet
0 300 600 900 Meters

- Approximate Vault Location
- Former Assembly and Maintenance Building
- Wastewater Lagoon
- FUDS Boundary
- Wastewater Treatment Area Detail

Drawn By: N.J. Date Drawn/Revised: 9/10/2018 Project No. J180557

Y:\Clients\US_ARMY_CORP_OF_ENGINEERS_LOUISVILLE\Raco_Army_Air_Field\MapDocs\180557\001_Updates\J180557 FIG 1-2 Site Map with Water Treatment Area Detail.mxd

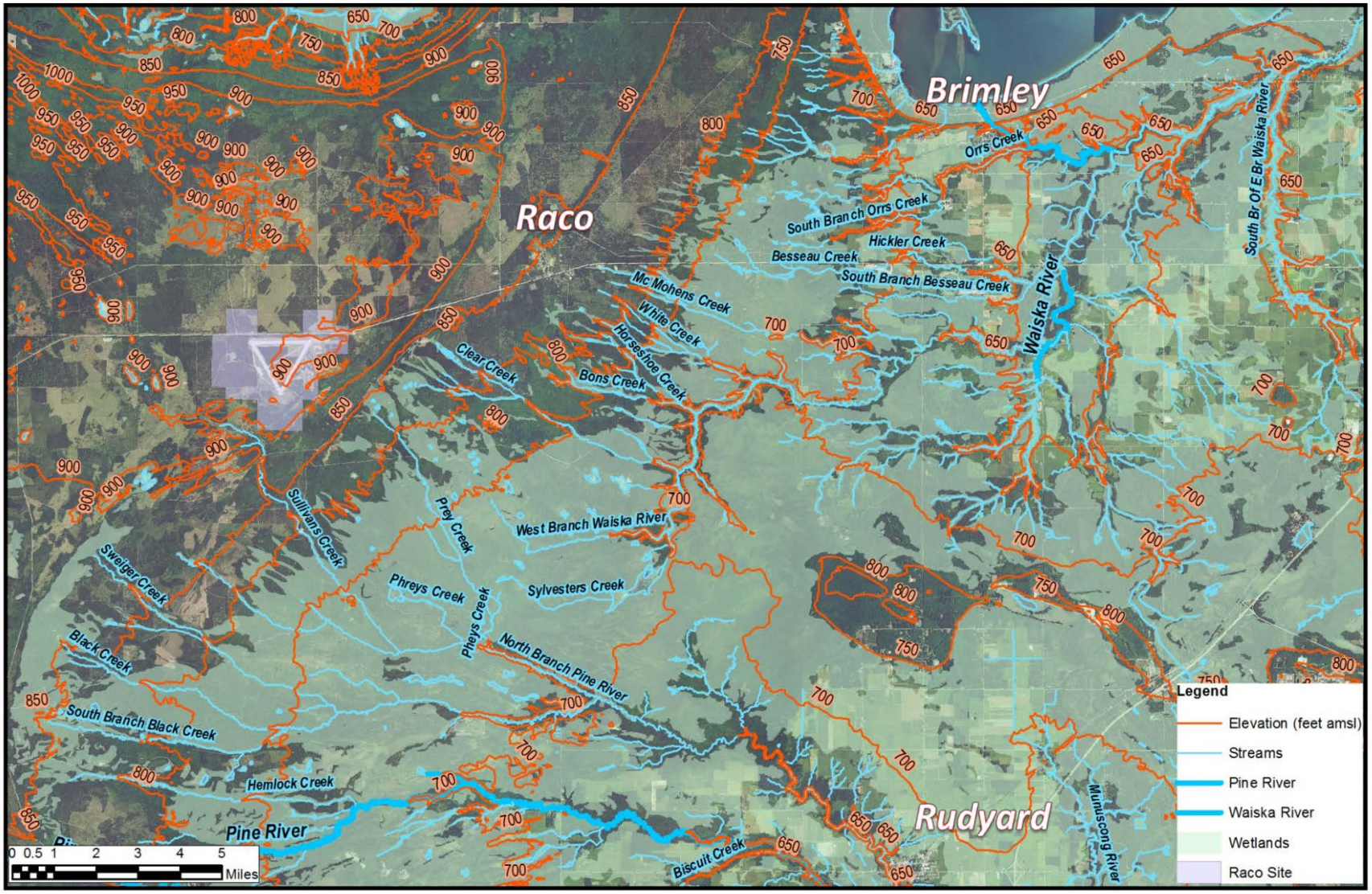


Figure 2-1
Regional topography, surface water, and wetlands

U.S. Army Corps of Engineers
Louisville District

TCE Groundwater Plume, Former Raco Army Airfield and Missile Site
Chippewa County, Michigan

Source: Remedial Investigation Report, April 2018

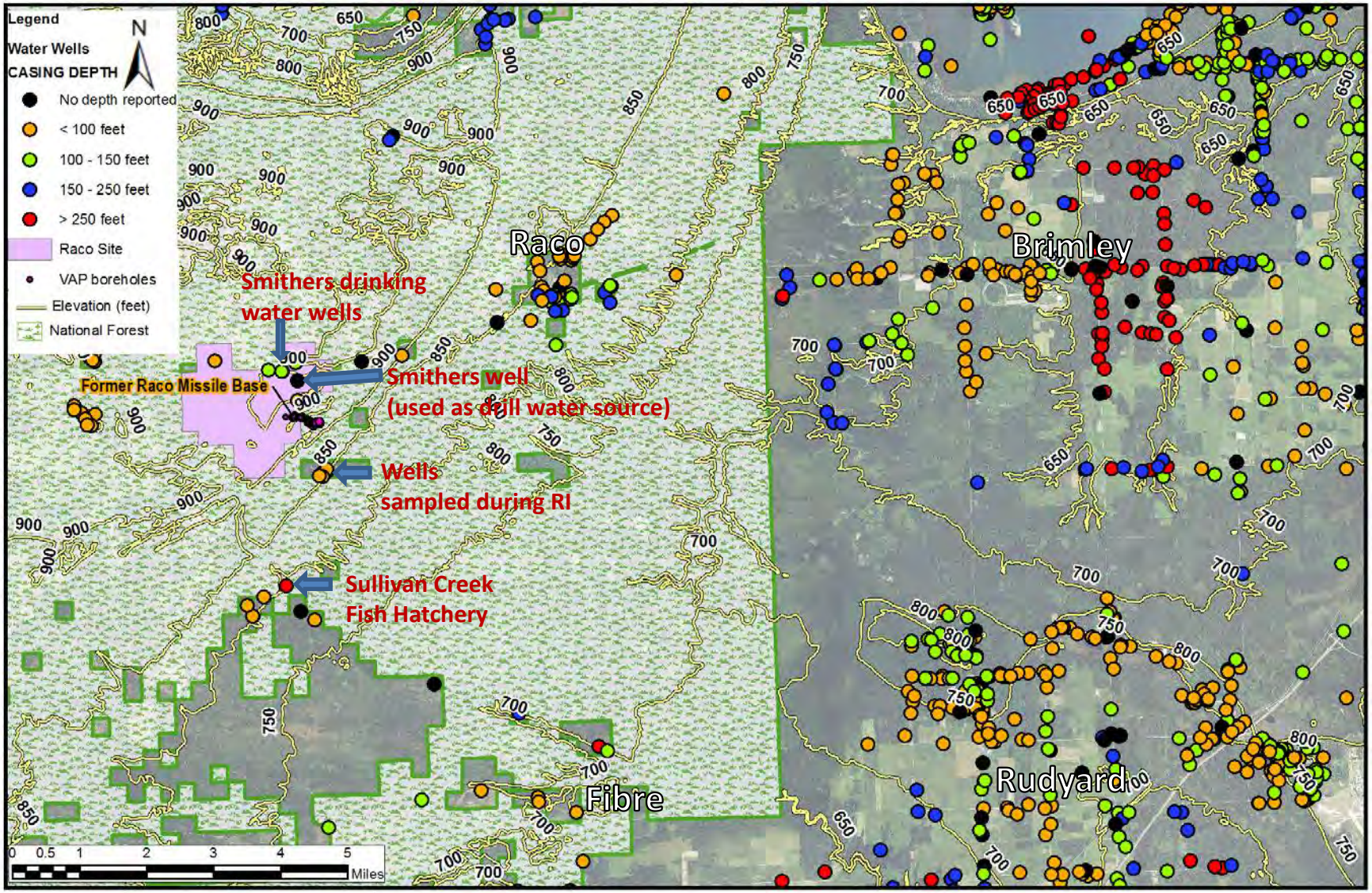


Figure 2-2
Land use and water wells in the vicinity of the Raco Site

U.S. Army Corps of Engineers
Louisville District

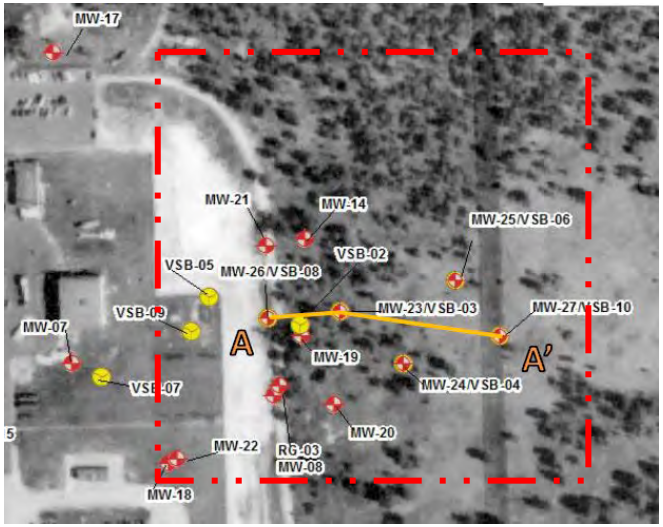
TCE Groundwater Plume, Former Raco Army Airfield and Missile Site
Chippewa County, Michigan

Source: Remedial Investigation Report, April 2018

Forested
New Field
Old Field
Ecological Reconnaissance Area

N

200 feet



A-A': Plume axis defined during 2009 investigation (GEO 2010, see Figure 2-6)
Aerial photograph from 1972

Figure 2-3
Habitat types observed during the Ecological Reconnaissance, August 29, 2014

U.S. Army Corps of Engineers
Louisville District

TCE Groundwater Plume, Former Raco Army Airfield and Missile Site
Chippewa County, Michigan

Source: Remedial Investigation Report, April 2018

Appendix A

RAAM

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DIVISION, GREAT LAKES AND OHIO RIVER
CORPS OF ENGINEERS
550 MAIN STREET
CINCINNATI, OH 45202-3222

CELRD-MID

REMOVAL ACTION APPROVAL MEMORANDUM (RAAM)

SUBJECT: Former Raco Army Airfield and Missile Site, Raco, Michigan (FUDS: E05MI0026)

1. Subject.

Former Raco Army Airfield and Missile Site, Raco, Michigan (FUDS: E05MI0026, Project 03).

2. Background.

The Formerly Used Defense Site (FUDS) known as the former Raco Army Airfield and Missile Site (Raco) property consisted of 1,825.94 acres acquired between 1942 and 1945 via various transfer permits, licenses, leaseholds, easements, and fee purchases. Around 1960, the missile base was constructed southeast of the airfield. Between 1962 and 1964, the Air Force released all property interests to the United States Forest Service (USFS) except for the 152.54-acre missile area and an additional 5-acre area. On 30 June 1973 and 24 March 1976, respectively, these 152.54-acre and 5-acre areas were released to the USFS. Since that time, the property has remained under USFS jurisdiction.

A Remedial Investigation (RI) is currently underway at Raco. The purpose of the RI is to characterize the nature, extent, and risks posed by a trichloroethene (TCE) groundwater plume identified by previous investigations. In 2016 and 2017, a source investigation was conducted in the wastewater treatment area of the former missile base to determine whether remnants of subsurface concrete wastewater treatment structures/vaults are still present and whether residual materials in these vaults could be a source of the TCE groundwater plume.

During the 2016 investigation, potential locations of the wastewater treatment vaults were identified and investigated. The vaults were designated Vaults 1 through 5. Test pits were excavated and partially exposed most of the vaults followed by deeper soil sampling with a drill rig. Vault 4 was identified to be investigated further.

In October 2017 an excavation was conducted to prepare for the investigation around the Vault 4 structure to assess if the vault is an active source to the existing TCE groundwater plume. The soil surrounding the vault was excavated to determine the size and condition of Vault 4. Based on the results of the excavation the vault is suspected to be an Imhoff Tank. No active leakages were observed; however the bottom of Vault 4 was not exposed, and its condition remains unknown. Samples were taken inside and outside Vault 4. No demolitions or removals were done below the ground surface at Vault 4 during past Department of Defense (DoD) operations; this remained the condition of Vault 4 prior to the 2016 and 2017 excavations. Vault 4 remains buried on site at Raco and partially uncovered.

Based on the observations made during the investigation activities, Vault 4 contains TCE contaminated sludge. The TCE contaminated sludge within Vault 4 is currently isolated and separate from the TCE groundwater plume at Raco. Vault 4 is understood to be structurally unsound presenting a risk of release of the TCE contaminated sludge into the underlying groundwater.

3. Description of Risk/Hazard to Public Health, Safety, or the Environment Posed by the Release or Threat of Release at the Project Location and the Expected Consequences of not Implementing a Removal Action:

   Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release ((40 CFR 300.415(b)(2)(2)(iii)) and High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface that may migrate ((40 CFR 300.415(b)(2)(2)(iv)).

TCE-contaminated soil/sludge is determined as a hazardous waste when its concentration exceeds the regulatory level identified in Table 1 – Maximum Concentration of Contaminants for Toxicity Characteristic (40 CFR 261.24). The United States Environmental Protection Agency (USEPA) Hazardous Waste Number, D040, is TCE with a regulatory level of 0.5 parts per million (ppm).

The analytical results presented in the 2017 Field Summary Report (Attachment 1) show that contaminant concentrations in soil/sludge inside Vault 4 are as high as 50 ppm for TCE. This is roughly 100 times the regulatory level. Based on professional judgment, it is likely that the soil/sludge is characteristically hazardous. Table 1 below shows the analytical result from the 2017 Field Summary Report taken within Vault 4. No active leakages were observed during the 2016 and 2017 investigations. This contamination is understood to be contained in Vault 4.

Table 1. TCE soil Analytical Results from 2017 Field Summary Report	
Max Concentration for Toxicity (40 CFR 261.24)	*0.5 ppm*
Sample	**Result**
VSB-42-13	50.0001 mg/kg

Although there is no evidence that the soils within Vault 4 are currently affecting soils outside of Vault 4, it is believed from the photos (Attachment 2) of the soil core columns (Figure 2. VSB39) and boring diagram that the contractor breached or partially breached a section of the interior concrete vault causing additional expansion/migration of contaminated sediments within the lower sections of the vault (see the "moist sand" below the concrete in the column profile). It is reasonable to assume that if the boring breached an interior, vertical concrete barrier, the

contaminated sludge will be migrating downward into the dry sand. Furthermore, it is impossible to know whether the lower section of the exterior casing or the foundation have cracks through which contamination could be released into the exterior environment.

Weather conditions that may cause hazardous substances, pollutants or contaminants to migrate or be released ((40 CFR 300.415(b)(2)(2)(v)).

Vault 4 is open to the environment with portions of exposed rebar and crushed concrete at the top of the structure. Vault 4 is not covered by any engineering barriers. In its present state it is likely that Vault 4 will continue to deteriorate as it continues to be exposed to conditions that occur at the site and within the vault (i.e. microbial induced deterioration of concrete, freeze-thaw cycles and the continued expansion of rebar due to rust). Eventually, this is likely to cause a release of the TCE contaminated sludge within this structure.

Potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants ((40 CFR 300.415(b)(2)(2)(i)) and Potential contamination of drinking water supplies or sensitive ecosystems ((40 CFR 300.415(b)(2)(2)(ii)).

Analytical data for soil and groundwater outside but in the immediate vicinity of Vault 4 indicate that Vault 4 is not likely acting as a current source of the existing TCE groundwater plume at Raco. The structural integrity of the vault is unknown. If a Removal Action is not performed and a TCE release from Vault 4 occurred, this will exacerbate the existing downgradient TCE groundwater plume. This could potentially reach private property owners with residential wells that are downgradient of the existing TCE groundwater plume.

Other situations or factors that may pose threats to public health or welfare of the United States or the environment ((40 CFR 300.415(b)(2)(2)((viii)).

The nature and extent of the TCE groundwater plume is considered to be delineated at this time. All stakeholders, which includes the state regulator and property owner, have agreed to stop further delineation of the plume due to the extreme costs associated with deeper investigations in the subsurface. At this time the TCE groundwater plume has been confirmed to be stable and not impacting any current human and ecological receptors.

The TCE groundwater plume is being addressed through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial process, moving into the Feasibility Study (FS) phase. The final Proposed Plan (PP)/Decision Document (DD) is not anticipated to occur until Fiscal Year 2020. The state and condition of Vault 4 cannot be guaranteed as the project moves through the CERCLA remedial process. If a Removal Action is not performed and a TCE release from Vault 4 occurs, all sampling, migration and risk assumptions used in the CERCLA remedial process for the TCE groundwater plume will be invalidated. This will have major financial consequences as the Army would be obligated to conduct further costly investigations in order to reevaluate the TCE groundwater plume's stability and delineate the TCE groundwater plume further.

Factors Not Considered Applicable

Factors not considered to be applicable are in this memorandum are: Threat of fire or explosion ((40 CFR 300.415(b)(2)(2)(vi)). The contents of Vault 4 do not present any explosive hazards. The availability of other appropriate federal or state response mechanisms to respond to the release ((40 CFR 300.415(b)(2)(2)(vii)). No other response mechanisms exists at this time.

4. Proposed Action.

The United States Army Corps of Engineers (USACE) recommends that a Non-Time Critical Removal Action (NTCRA) to be undertaken on the basis of mitigating the risk of actual or potential contamination found within Vault 4 at the former Raco Army Airfield and Missile Site in Raco, Michigan. The appropriateness of this recommendation is taken in consideration with the high levels of detected hazardous substances in soils largely at or near the surface that may migrate, the weather conditions that may cause hazardous substances to migrate or be released and the potential exposure to nearby human populations and of drinking water supplies, and other factors such as the threat to the stability of the TCE groundwater plume that is being addressed by the CERCLA remedial process ((40 CFR 300.415(b)(2)(2)(i,ii,iii,iv,v, viii)).

The 2017 field effort has characterized the media around Vault 4 and indicated that Vault 4 is not a current source of the TCE groundwater plume. The NTCRA will assess the mitigation of the potential hazard posed by the hazardous contents, TCE-contaminated soil/sludge, found inside Vault 4 at Raco. An area of approximately 6,400 square feet will be disturbed for excavation. All hazardous substances, pollutants or contaminants recovered during the removal action, including all investigation derived waste, will be characterized and properly disposed of in a nearby off-site facility. A determination as to the ultimate fate of Vault 4 will be made in the Action Memorandum. Confirmation samples will be taken around the surrounding soil to confirm that the removal is complete and that no migration has occurred as a result of the removal action. Approximately 150 cubic yards of clean soil may be used as backfill. Once the action has been completed the area will be restored in accordance with USFS requirements.

5. Regulatory Enforcement Activities (if any):
None

6. Schedule and Estimated Cost.

The USACE Environmental & Munitions Center of Expertise (EM CX) provided concurrence with the proposed removal action on 27 April 2018. Upon CELRD signature, the signed RAAM will be forwarded to USACE Headquarters Directorate of Military Programs (CEMP-CED) in accordance with the FUDS Removal Action Approval Process Interim Guidance Document (IGD) issued by CEMP-CED on 14 January 2013. The Engineering Evaluation/Cost Analysis (EE/CA) phase will then be opened in FUDS Management Information System (FUDSMIS).

The preliminary estimated cost of the proposed removal action is $250,000. It is anticipated that USACE Louisville District (LRL) will award a task order during the third quarter of Fiscal Year 2018 for the execution of the NTCRA and its associated action. On-site work will begin within

six months of the signature date of the Action Memorandum, following the public comment period. The removal action will be coordinated with and reviewed by the USFS, MDEQ, and USEPA Region 5.

7. Approval and Signature.

JASPER.KEVIN.L.1230608519

Digitally signed by JASPER.KEVIN.L.1230608519
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=JASPER.KEVIN.L.1230608519
Date: 2018.05.11 08:35:40 -04'00'

11 May 2018

Kevin Jasper, PE, PMP
FUDS Program Manager
Great Lakes and Ohio River Division

Date

2 Attachment(s)
1. Table 3 of the 2017 Field Summary Report
2. Photos & Boring Diagram from 2017 Field Effort

Attachment 1: Table 3 of the 2017 Field Summary Report

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

	Analyte	TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
	USEPA Residential Soil RSL [1]	0.41	16	0.059
	MDEQ Groundwater Protection Criterion	0.1	1.4	0.04
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-35-17.5	9/18/2017	0.009 U	0.009 U	0.009 U
VSB-35-20	9/18/2017	0.009 U	0.009 U	0.009 U
VSB-35-22.5	9/18/2017	0.010 U	0.010 U	0.010 U
VSB-35-25	9/18/2017	0.009 U/ 0.009 U	0.009 U/ 0.009 U	0.009 U/ 0.009 U
VSB-38-2.5	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-38-5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-38-7.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-38-10	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-38-12.5	9/23/2017	0.011 U	0.011 U	0.011 U
VSB-38-15	9/24/2017	0.011 U	0.011 U	0.011 U
VSB-38-17.5	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-38-20	9/24/2017	0.011 U	0.011 U	0.011 U
VSB-38-22.5	9/24/2017	0.009 U	0.009 U	0.009 U
VSB-38-25	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-38-27.5	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-39-5	9/21/2017	0.008 U	0.008 U	0.008 U
VSB-39-10	9/21/2017	0.008 U / 0.007 U	**0.435 / 0.655**	0.008 U / 0.007 U
VSB-39-12.5	9/21/2017	0.074 U	**3.050**	0.074 U
VSB-39-13	9/21/2017	0.162 U	**13.683**	0.162 U
VSB-39-14	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-39-16	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-2.5	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-5	9/22/2017	0.004 U	0.004 U	0.004 U
VSB-41-7.5	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-8-13	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-14	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-15	9/22/2017	0.009 U / 0.008 U	0.009 U / 0.008 U	0.009 U / 0.008 U
VSB-41-16	9/22/2017	0.009 U	0.009 U	0.009 U
VSB-41-18	9/22/2017	0.011 U	0.011 U	0.011 U
VSB-41-20	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-22	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-24.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-41-27	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-41-29.5	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-41-32	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-41-34.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-41-37	9/23/2017	0.012 U / 0.008 U	0.012 U / 0.008 U	0.012 U / 0.008 U
VSB-41-39.5	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-41-42	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-42-13	9/24/2017	**50.001**	**55.884**	0.452 U

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

	Analyte	TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
	USEPA Residential Soil RSL [1]	0.41	16	0.059
	MDEQ Groundwater Protection Criterion	0.1	1.4	0.04
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-46-2.5	9/28/2017	0.014 U	0.014 U	0.014 U
VSB-46-5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-46-10	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-12.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-15	9/28/2017	0.007 U	0.007 U	0.007 U
VSB-46-17.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-20	9/28/2017	0.011 U	0.011 U	0.011 U
VSB-46-22.5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-46-25	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-27.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-30	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-32.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-35	9/28/2017	0.011 U	0.011 U	0.011 U
VSB-46-37.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-40	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-42.5	9/28/2017	0.019 U	0.019 U	0.019 U
VSB-46-45	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-49	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-50	9/28/2017	0.008 U	0.008 U	0.008 U
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VSB-47-5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-7.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-10	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-12.5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-15	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-47-17.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-47-20	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-22.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-25	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-27.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-47-30	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-32.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-35	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-47-37.5	9/28/2017	0.015 U	0.015 U	0.015 U
VSB-47-40	9/28/2017	0.014 U	0.014 U	0.014 U
VSB-47-42.5	9/28/2017	0.013 U	0.013 U	0.013 U
VSB-47-45	9/28/2017	0.011 U	0.011 U	0.011 U

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

	Analyte	TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
USEPA Residential Soil RSL [1]		0.41	16	0.059
MDEQ Groundwater Protection Criterion		0.1	1.4	0.04
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-48-2.5	9/29/2017	0.011 U	0.011 U	0.011 U
VSB-48-5	9/29/2017	0.019 U	0.019 U	0.019 U
VSB-48-7.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-48-10	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-48-12.5	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-15	9/29/2017	0.012 U	0.012 U	0.012 U
VSB-48-17.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-48-20	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-22.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-48-25	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-27.5	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-30	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-32.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-48-35	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-37.5	9/29/2017	0.011 U	0.011 U	0.011 U
VSB-48-40	9/29/2017	0.013 U	0.013 U	0.013 U
VSB-48-42.5	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-48-45	9/29/2017	0.008 U	0.008 U	0.008 U
VSB-49-2.5	9/29/2017	0.011 U	0.011 U	0.011 U
VSB-49-5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-7.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-10	9/29/2017	0.012 U	0.012 U	0.012 U
VSB-49-12.5	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-49-15	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-17.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-20	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-22.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-25	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-27.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-30	9/29/2017	0.011 U	0.011 U	0.011 U
VSB-49-32.5	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-35	9/29/2017	0.010 U	0.010 U	0.010 U
VSB-49-37.5	9/29/2017	0.009 U	0.009 U	0.009 U
VSB-49-40	9/29/2017	0.008 U	0.008 U	0.008 U
VSB-49-42.5	9/29/2017	0.007 U	0.007 U	0.007 U
VSB-49-45	9/29/2017	0.009 U	0.009 U	0.009 U

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

[2] screening levels for cis-1,2-DCE shown here. It is the lower of the cis and trans isomer RSLs.

[3] screening levels for VC shown here.

MDEQ: Michigan Department of Environmental Quality; mg/kg: milligram per kilogram; RSL: Regional Screening Level;

U: not detected; USEPA: U.S. Environmental Protection Agency;

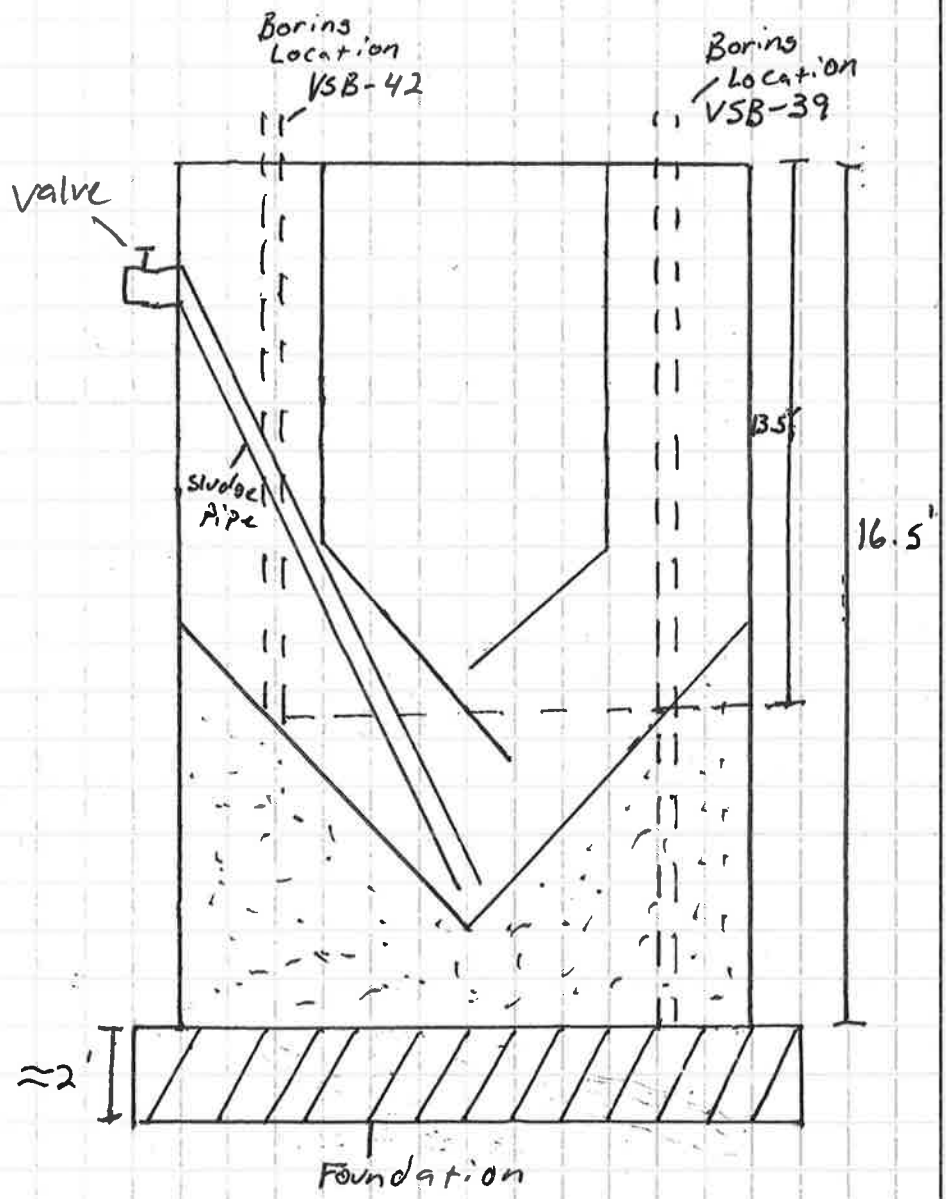
DCA: dichloroethane; DCE: dichloroethene (sum of cis-1,2-DCE and trans-1,2-DCE); TCE: trichloroethene; VC: vinyl chloride

Attachment 2: Photos & Boring Diagram
from 2017 Field Investigation

GEO Consultants
325 Kentucky Avenue
Kevil, KY 42053
(270) 462-3882
Fax (270) 462-3887

Client: _____
Job #: _____
Prepared by: _____
Date: _____
Checked by: _____
Page: _____ of: _____

NOTES/CALCULATION WORKSHEET



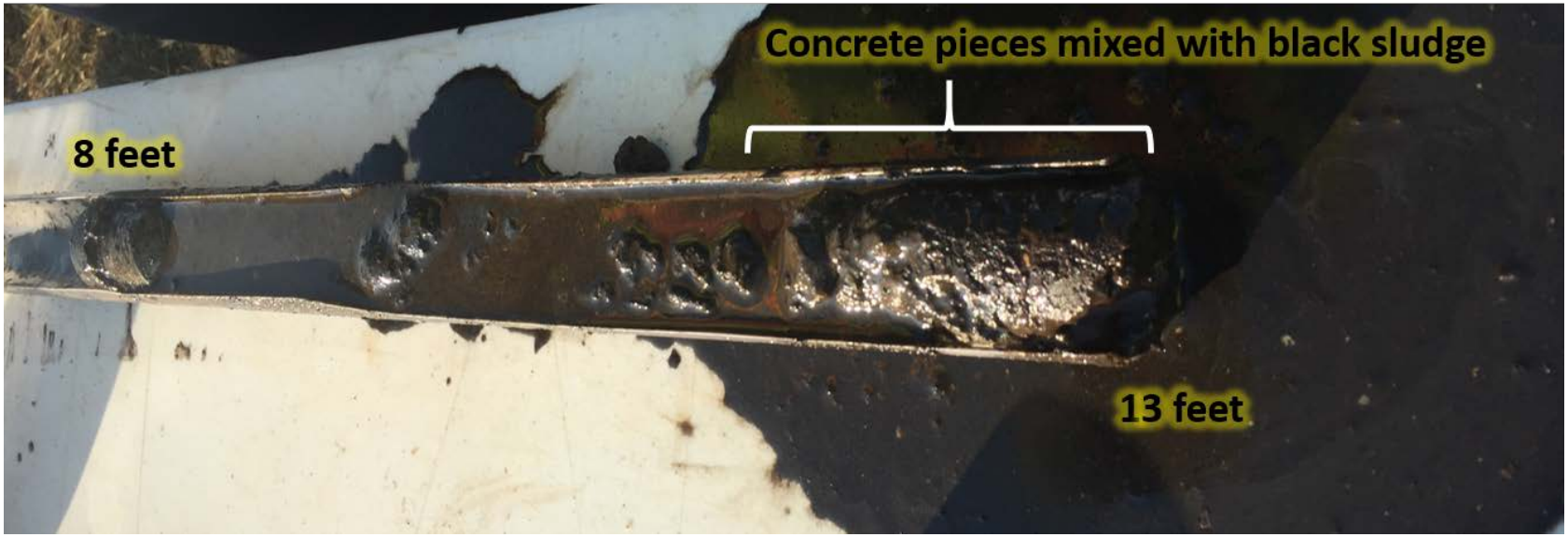


Figure 1. VSB42, soil core from 8 to 13 feet.

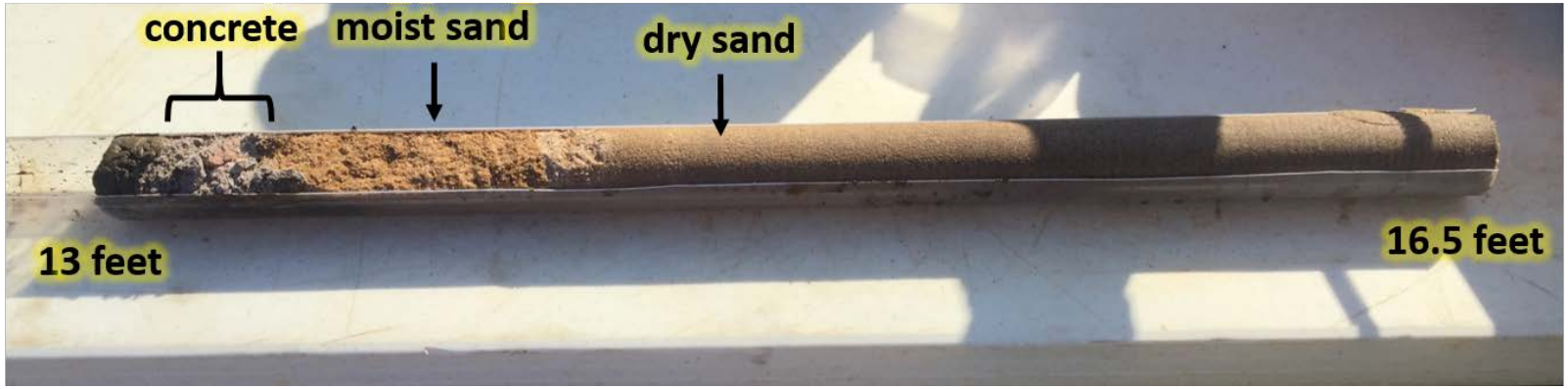


Figure 2. VSB39, Soil Core from 13 to 16.5 feet.

Appendix B

Field Summary Report

TO: Mr. Juan Afable, Technical Manager, U.S. Army Corps of Engineers (USACE), Louisville District; and Mark Nichter, Contracting Officer's Representative (COR), USACE Louisville District; Josh Van Bogaert, USACE Louisville District
FROM: Kim Morris, Project Manager, GEO Consultants Corporation (GEO)
DATE: November 17, 2017
DCN: GEO/17-536
TRANSMITTAL: W91237-15-D-0011-CY02-17-033
SUBJECT: Field Summary Report, Source Investigation, Former Raco Army Airfield and Missile Site, Chippewa County, Michigan
ATTACHMENTS:

Figures
- Figure 1: Raco Site Layout Map
- Figure 2: Results of the Passive Soil Gas Survey and 2017 excavation extents
- Figure 3: Detections from the 2017 Soil and Groundwater Samples

Attachment 1: Photographs
Attachment 2: Geophysical Report
Attachment 3: Results of Passive Soil Gas Survey
Attachment 4: Laboratory Results
- Table 1. Analytical results of target VOCs in monitoring well samples
- Table 2. Analytical results of target VOCs in soil and liquid samples from Vaults 3 and 4
- Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory
- Table 4. Analytical results of target VOCs in 2017 groundwater samples analyzed by the on-site mobile laboratory
- Table 5. Comparison of analytical results in soil samples analyzed by the on-site mobile laboratory and the off-site QA laboratory
- Table 6. Comparison of analytical results in groundwater samples analyzed by the on-site mobile laboratory and the off-site QA laboratory

Attachment 5: Preliminary Boring Logs

On Tuesday, August 9, 2017, GEO Consultants (GEO) and its subcontractors began a source investigation at the Former Raco Army Airfield and Missile Site. This investigation focused on the former wastewater treatment facility (Figure 1). The facility was targeted after the discovery of a note describing the partial demolition of missile base structures including the wastewater features (Barr 2002). A field effort in October 2016 that included excavation activities identified several buried vaults that remained onsite. Soil samples from the Vault 4 area showed evidence of trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE), with the highest concentrations of cis-1,2-DCE measured in soil boring SB-04 which was thought to be located adjacent to Vault 4 at that time (USACE 2017).

The investigation began by locating and flagging the target area for a geophysical exploration and passive soil gas survey with a Trimble GEO 7x hand held global positioning system (GPS). A 100-foot x 100-foot grid was laid out to target the wastewater treatment area. Once the grid was laid out, a combination of Electrical Resistivity Imaging (ERI) and Electromagnetic Induction (EMI) was used on August 9 and 10, 2017 (see photograph in Slide 1, Attachment 1). Photographs from the field effort are included in

Attachment 1. The report for this geophysical exploration is in Attachment 2. The EMI findings included high conductivity values throughout the waste water vault area indicating conductive material (steel reinforced concrete, metallic objects, clay soils, or water saturated material.) Exhibit 3 in Attachment 2 shows areas of high magnetic susceptibility indicating buried metallic material. This correlates well with the exposed rebar found around Vault 4. The ERI results showed areas of lower resistive values that indicated potential clayey material, buried object, metallic material, pipes, etc. However, a high amount of interference was encountered due to the highly resistive nature of the sandy soil.

After completion of the geophysical exploration, the passive soil gas sampling grid was laid out with mason line and stakes. On August 11, 2017, the passive soil gas samplers were installed by drilling a 1.5-inch diameter hole 1.5-feet deep followed by a 0.75-inch diameter hole 3-feet deep using a hammer drill. A 1-foot metal tube was then placed in the hole and the soil gas sampler was deployed at approximately 10-inches below ground surface (bgs). The location of the samplers within the grid were flagged and surveyed (Slide 2, Attachment 1). The samplers were removed on August 24, 2017 giving them approximately 13 days of deployment (Slide 3, Attachment 1). The results of the passive soil gas survey are included in Attachment 2. The results show detections of TCE in SG011, SG022, and SG091; toluene was detected in SG025, SG063, and SG080 (Figure 2).

On August 12-23, 2017, 16 groundwater samples were collected from 14 monitoring wells (Slide 4, Attachment 1) (MW-34 has 3 nested microwells). The samples were analyzed for target VOCs [TCE, cis-1,2-DCE, trans-1,2-dichloroethene (trans-1,2-DCE), and vinyl chloride]. The results from the analysis are included in Table 1 of Attachment 4.

On September 15, 2017, exploration of Vault 4 with an excavator began. A hand-auger was used to collect soil samples from 3 locations in the vault prior to excavation (Slide 5, Attachment 1). The results of the off-site analysis for these samples are included in Table 2 of Attachment 4. During excavation it was determined that the rectangular vault identified in October 2016 was the center chamber of Vault 4 (Slide 6 in Attachment 1). The excavation extended to approximately 8 feet where, because of the inner chamber walls, it was no longer safe to continue removing material from inside the vault for fear of damaging the exterior and possibly causing a release. It was assumed that this is the top chamber of a multi-chambered vault; additional soil samples were collected from the northern and southern compartments and an aqueous sample was collected from the center compartment. The excavation continued along the outside of the Vault to determine the dimensions. Vault 4 was determined to be approximately 18 feet tall, instead of the anticipated 8-10 feet, and could not be demolished with the on-site equipment (Slide 7, Attachment 7). Representatives from GEO and USACE were contacted to determine a path forward regarding removal of Vault 4. It was decided that Vault 4 would not be removed, but as much of the contents of the upper chamber would be removed as possible with the available equipment, and the drill rig would be used to attempt to collect deeper soil samples from within Vault 4. The material that was removed from the upper portion of Vault 4 was placed in on-site roll-off bins and the vault was backfilled with clean fill from above the tank while leaving the lip of the vault exposed for surveying.

On September 16, 2017, exploration of additional areas took place where the passive soil gas survey detections were found. In the area where TCE was detected at SG091, excavations revealed perforated clay pipes and a gravel bed approximately 3 feet bgs. The field crew assumed this might have been a leach field (Slide 8, Attachment 1). The area was backfilled. There were TCE detections in the PSG data in SG022 and SG011 that were investigated north of Vault 3. First, Vault 3 was uncovered to verify its extent and remove the contents of the vault; several roll-off bins of debris and one roll-off bin of tires was removed from the vault (Slide 9, Attachment 1). Nothing was found with the excavator at the locations of SG022 and SG011 after excavating approximately 10 feet. A round tank (approximately 6 feet in diameter) was located east

of Vault 3 (Slide 10, Attachment 1); it was excavated as deep as possible and a pump or fan shaft was identified. The excavation was backfilled and a soil sample was collected with a hand auger and sent to an off-site laboratory for analysis; the target VOCs were not detected and the results from the analysis are included in Table 2 of Attachment 4. Next the area where the ERI survey identified the potential location of Vault 1 (which could not be located in October 2016 based on ground penetrating radar). No evidence of a vault or other buried structure/debris was found in this excavation (Slide 11, Attachment 1).

On September 18, 2017, the drilling contractor arrived with a GeoProbe 8040 rig and Waterloo sampling equipment (Slide 12, Attachment 1) for soil and groundwater sampling efforts. Soil and groundwater samples were collected from VSB-35 to VSB-45 between September 18-25, 2017. On September 27, 2017, a sonic rig and push-ahead groundwater sampler (Slide 12, Attachment 1) arrived and was used to collected soil and groundwater samples from VSB-46 through VSB-49. Samples were sent to an on-site mobile laboratory for analysis of TCE, dichloroethene (DCE; total of cis- and trans-1,2-DCE), and vinyl chloride. A subset of the samples were sent to off-site laboratories for quality control and USACE split samples. The results of the analysis of the on-site mobile laboratory and off-site laboratory are included in Attachment 4. The on-site mobile laboratory results for soil samples are in Table 3 of Attachment 4 and Table 4 for groundwater. A comparison of the on-site and off-site soil sample results are in Table 5 for soils and Table 6 for groundwater (Attachment 4).

In general, the non-detections from the on-site laboratory were confirmed by the off-site samples. The detections in VSB-39 soil samples (from within Vault 4) were comparable (same order of magnitude but were generally higher in the off-site analyses). TCE and DCE were detected by the on-site mobile laboratory in the soil samples collected from within Vault 4 (VSB-39 located on the south side of Vault 4). DCE detections ranged from 0.435 to 13.683 mg/kg at depths from 10-13 feet bgs in VSB-39 (Table 3, Attachment 4). The DCE detections in VSB-39 were confirmed by QA samples sent to an off-site laboratory (Table 5, Attachment 4). TCE and vinyl chloride were also detected in VSB-39 at depths ranging from 12.5 to 14 feet bgs (the VSB-39 sample from 10 feet bgs was not submitted to the QA laboratory). DCE was also detected at 55.884 mg/kg at 13 feet bgs in VSB-42 (north site of Vault 4, Table 3, Attachment 4). TCE was also detected at 13 feet bgs in VSB-42 at 50.001 mg/kg (Table 3, Attachment 4; this sample was not submitted to the QA laboratory for confirmation). The on-site mobile laboratory detected TCE near the top of the groundwater table in VSB-37, 38, 40, 41, and 46 (Table 4, Attachment 4). These locations were surrounded by VSBs where TCE was not detected by the mobile laboratory (VSB-43, 44, 45, 47, 48, 49), but split samples from some of these locations were sent to an off-site laboratory. TCE was detected in VSB-43, 44, 45, and 48 by the off-site laboratory ranging from 0.020 J to 1.1 µg/L below the mobile laboratories detection limits (2 µg/L, Figure 3; Table 6, Attachment 4). Split samples were not collected from VSB-47 or 49.

After the completion of drilling activities, the soil and groundwater sample locations were surveyed by a licensed surveyor as well as the visible extents of Vault 4 (Slide 13, Attachment 1). Upon the completion of field tasks, surfaces were smoothed and returned to their original shape as much as possible. The area was then seeded, fertilized, and covered in straw (Slide 14, Attachment 1) to restore the area to its state prior to the investigation.

In conclusion, the objectives of the investigation were achieved. The extents of Vault 4 were verified, groundwater samples were collected from 13 locations, and soil samples were collected from 9 soil borings, the contents were removed from Vault 4 (to the maximum extent practicable with the available equipment) and Vault 3, and the contents of Vault 4 were characterized (to the extent practical). The draft boring logs for the 9 soil boring locations are included in Attachment 5. The investigation was injury and incident free, and completed on schedule.

GEO will include further analysis and discussion of the results of the field effort in the Draft Revision 1, RI report to discuss this investigation and results for review before submission of the Draft-Final RI report to the regulators.

References

Barr (Barr Engineering Company) 2002. Raco Document Review and Site Evaluation. Prepared for the U.S. Department of Agriculture Forest Service, Hiawatha National Forest. October.

USACE (U.S. Army Corps of Engineers) 2017. Work Plan Addendum, Remedial Investigation/Feasibility Study, TCE Groundwater Plume, Potential Source Investigation, Former Raco Army Airfield and Missile Site, Chippewa County, Michigan, FUDS Property No. E05MI0026. August.

FIGURES

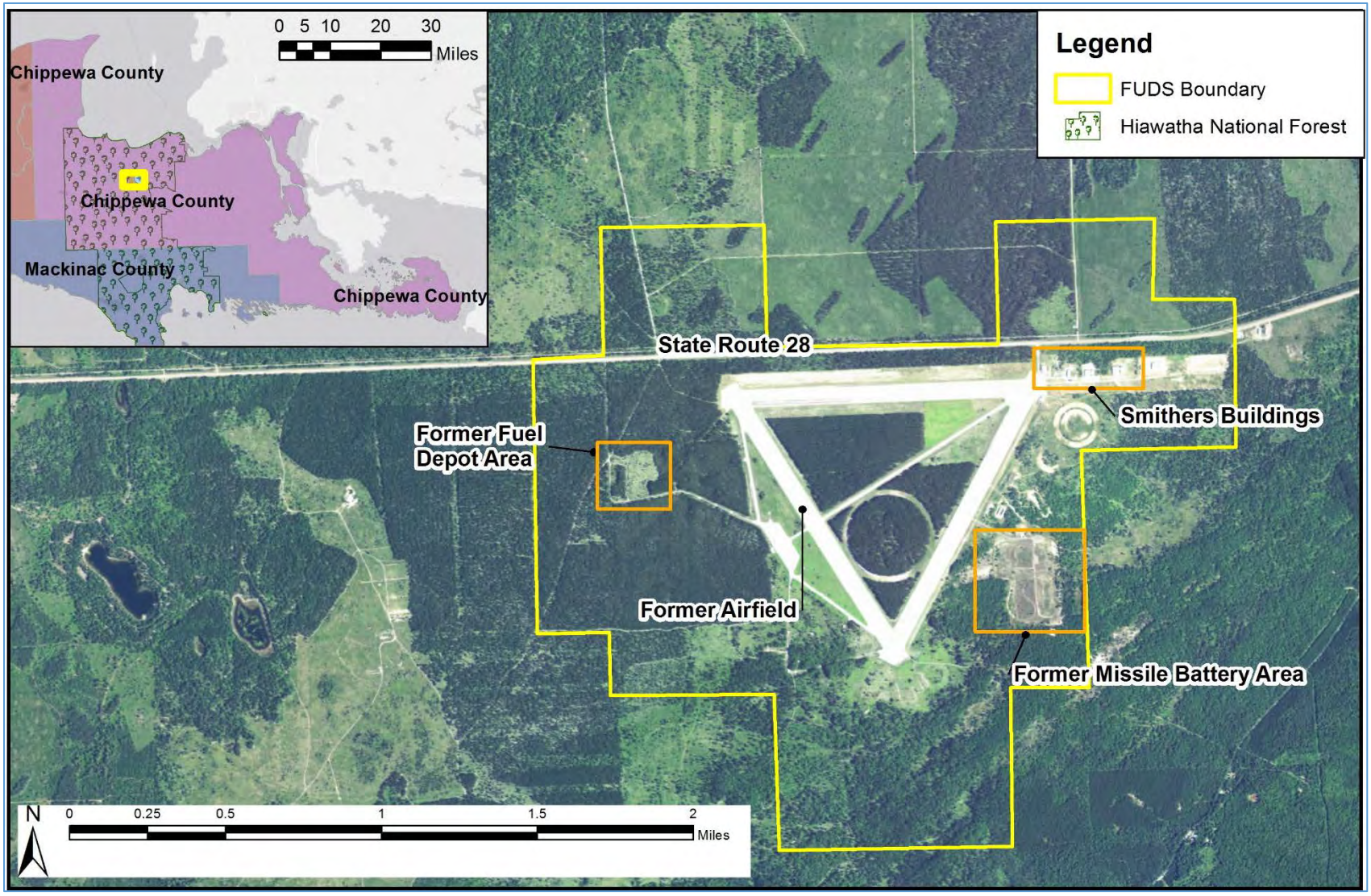


Figure 1. Raco Site Layout Map

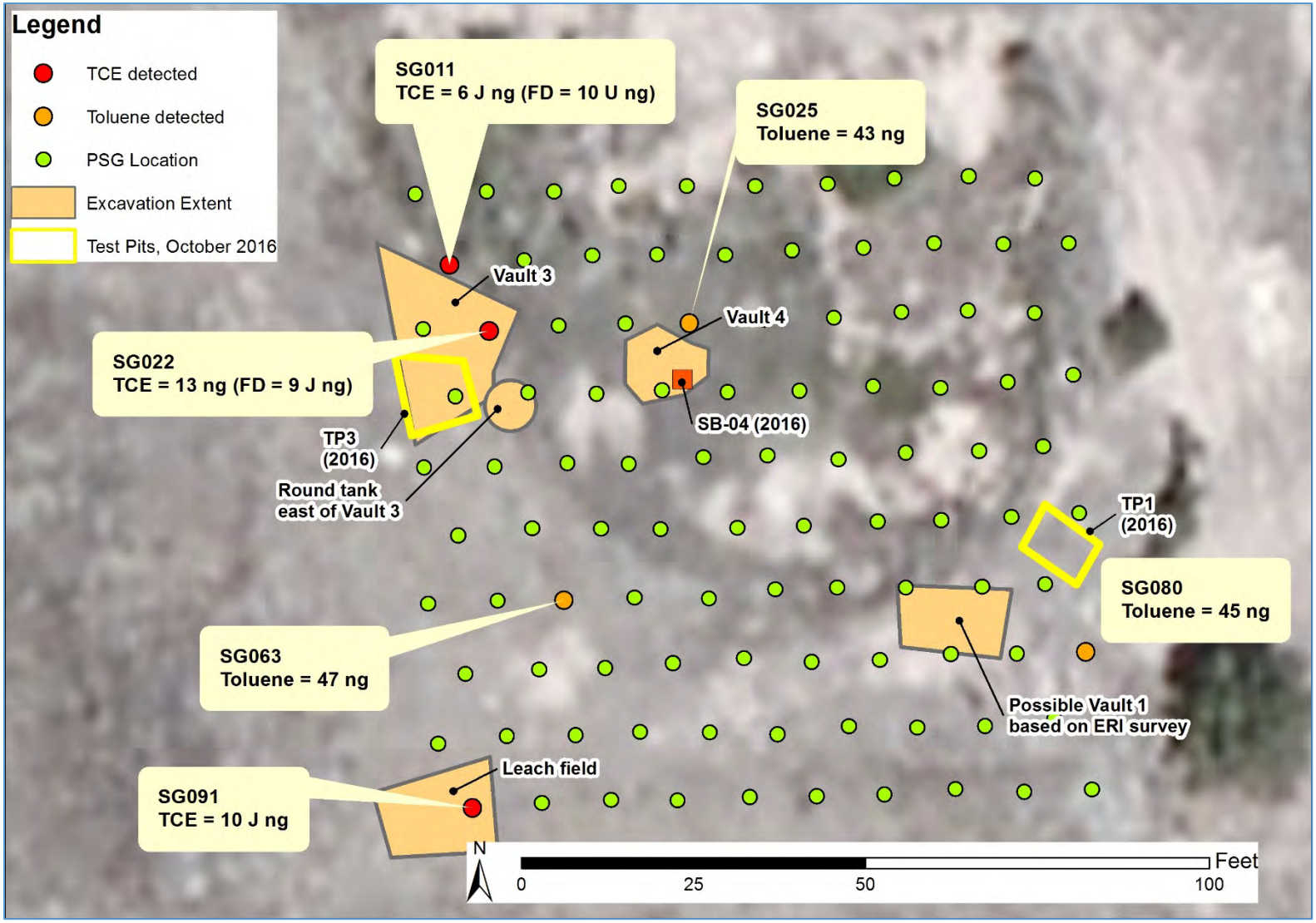


Figure 2. Results of Passive Soil Gas Survey and 2017 excavation extents

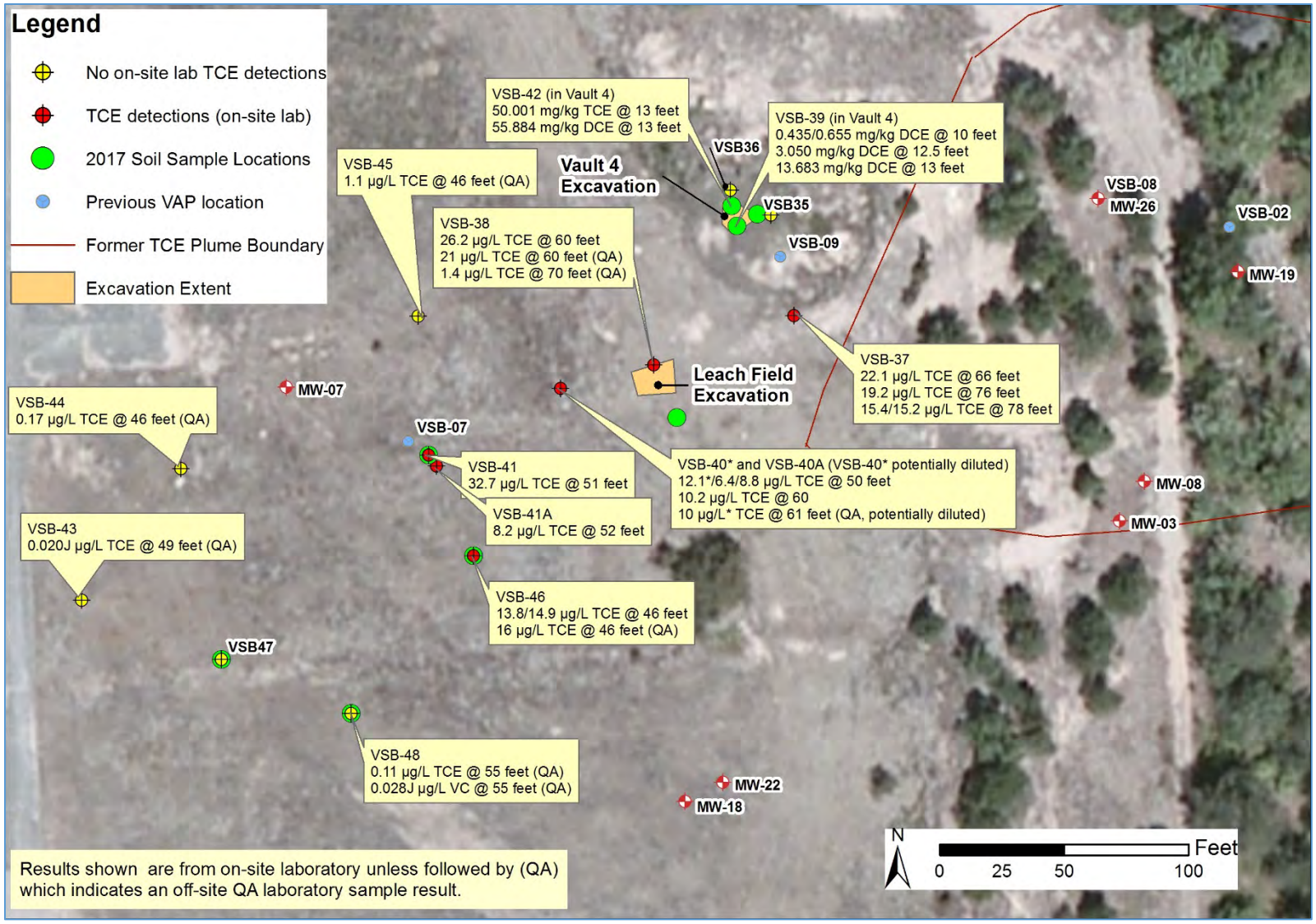


Figure 3. Detections from the 2017 Soil and Groundwater Samples

ATTACHMENT 1: PHOTOGRAPHS

Photograph 1. Electrical Resistivity Imaging and Electromagnetic Induction geophysical exploration

Photograph 2. Passive soil gas grid and surveyed sample locations

Photograph 3. Retrieval of the passive soil gas samplers

Photograph 4. Groundwater sampling activities

Photograph 5. Soil cores from Vault 4
(hand auger to 5 feet on left, sample from drill rig ~13 feet bgs on right)

Photograph 6. Excavation of Vault 4, upper chamber portion

Photograph 7. Excavation of area around Vault 4

Photograph 8. Possible leach field

Photograph 9. Tires removed from Vault 3

Photograph 10. Round tank located east of Vault 3

Photograph 11. Excavation area potential Vault 1 area

Photograph 12. Groundwater samplers systems
(Waterloo sampler on left, Sonic push-ahead on right)

Photograph 13. Extent of Vault 4 for surveying

Photograph 14. Vault 4 area after activities completed and area reseeded and covered in straw

ATTACHMENT 2: GEOPHYSICAL REPORT

September 14, 2017

GEO Consultants Corporation
325 Kentucky Avenue
Kevil, Kentucky 42053

Attn: Ms. Natalie Magill, PhD, PE
P: [270] 462-3882, ext. 204
E: magilln@geoconsultantscorp.com

Re: Geophysical Exploration Report
USACE Huntington District Contract W91237-15-D-0011
Waste Water Vault System
Raco Field, Brimley, Michigan
Terracon Project No. N11715197

Dear Ms. Magill:

Terracon Consultants, Inc. (Terracon) performed geophysical exploration services consisting of a combination of Electrical Resistivity Imaging (ERI) and Electromagnetic Induction (EMI) on August 9 & 10, 2017. The purpose of the geophysical exploration was to locate any potential tanks, pipes, debris, and other buried obstructions in the near surface.

1.0 GEOPHYSICAL EXPLORATION

1.1 Electromagnetic Induction (EMI)

Terracon utilized a system consisting of an EM-31 ground conductivity meter with an approximate penetration depth of 10 to 18 feet. The system consists of a 10-foot long pipe antenna that is carried on the side of the operator. The field data was continuously recorded as the operator walked across the surface and each measurement was referenced to GPS coordinates. The recorded data was returned to the office for processing, analysis, and interpretation.

This electromagnetic inductive technique allows measurement without ground contact. The meter maps soil materials, groundwater contaminants, buried objects, or any subsurface feature associated with changes in electrical conductivity. Ground conductivity (quad-phase) and magnetic susceptibility (in-phase) measurements are recorded. The unit can measure small changes in conductivity and the in-phase component is useful for the detection of buried metallic structures and waste material.

EMI Survey Design

The designated area was an approximate 100-foot by 100-foot square that was marked at the site by Geo Consultants personnel. Data was collected within the survey area using a 2-foot by 2-foot grid.

1.2 Electrical Resistivity Imaging (ERI)

Terracon utilized an Electrical Resistivity Imaging (ERI) system consisting of an Advanced Geosciences Inc. (AGI) SuperSting R8 control unit. This method utilizes potential and current electrodes that function independently of one another to measure the potential field using the dipole-dipole technique. A transmitting current dipole is followed by a series of potential dipoles which measure the resulting voltage gradient at each station. As the transmitting dipole is advanced along the electrodes, the resulting gradient measurements will be collected as a 2D section below the survey array. After field collection, the resistivity data was processed using EarthImager 2D (engineered by AGI), an inversion and modeling software package.

ERI Survey Design

Six (6) ERI survey lines were conducted throughout the designated area (see Exhibit 1). A description of each line is listed below.

- ERI survey lines 1 and 2 were conducted to investigate greater depths to characterize the subsurface geology for an understanding of potential contaminant migration.
  - Line 1 consisted of an approximate 550 foot linear array with 56 electrode stakes that were inserted into the ground, spaced approximately 10 feet apart in an approximate southwest-northeast orientation.
  - Line 2 consisted of an approximate 500 foot linear array with 51 electrode stakes that were inserted into the ground, spaced approximately 10 feet apart in an approximate north-south orientation.
- ERI survey lines 3 through 6 were high resolution, shallow lines conducted to investigate the vault structures.
  - Line 3 consisted of an approximate 110 foot linear array with 56 electrode stakes that were inserted into the ground, spaced approximately 2 feet apart.
  - Line 4 consisted of an approximate 110 foot linear array with 56 electrode stakes that were inserted into the ground, spaced approximately 2 feet apart.
  - Line 5 consisted of an approximate 110 foot linear array with 56 electrode stakes that were inserted into the ground, spaced approximately 2 feet apart.
  - Line 6 consisted of an approximate 110 foot linear array with 56 electrode stakes that were inserted into the ground, spaced approximately 2 feet apart.

2.0 GEOPHYSICAL FINDINGS

2.1 EMI Findings

The EMI data is provided as contour maps of the conductivity measurements on Exhibits 2 and 3. The conductivity data (Exhibit 2) displays high conductivity values throughout most of the waste water vault area and has minimal values in the surrounding area. The high values indicate conductive material such as steel reinforced concrete, metallic objects, clay soils, and water saturated material. The negative values are caused when the antenna passes over a very conductive object. The magnetic susceptibility (Exhibit 3) also shows high values within the vault system area and drops to almost zero in the surrounding area. High magnetic susceptibility values indicate metallic material. The EMI data does not differentiate small individual features but rather outlines the entire conductive and metallic area within the survey area.

2.2 ERI Findings

The cross-sectional images generated from the ERI testing are attached as Exhibits 4 through 6. The images are representations of the electrical resistivity of the subsurface. In general, high resistivity values (red, orange, and yellow) are indicative of sandy or silty material. Lower resistivity values (green, blue, and purple) are indicative of clayey material or buried objects that may consist of metallic material. On the exhibits, the areas of potential tanks, pipes, debris, and other buried obstructions are outlined. Our data interpretation is based on our experience with the ERI method, the existing boring logs, and the expected locations of the waste water vault system. Due to the highly resistive nature of the sandy soil, contact resistance of electrodes were extremely high. All troubleshooting measures recommended by AGI were followed, which lowered contact resistances, however, an amount of interference was expected and encountered.

Line 1 – The cross-section shows a general trend of a layer of high resistivity down to a depth of approximately 60 feet. Below that depth is a layer of low resistivity. This is consistent with the boring logs showing the subsurface that was tested to be fine sands and the water table to be at approximately 50 - 60 feet below ground surface. An area of lower resistivity is seen between stations 330 and 370 and coincides with the location of the waste water vaults.

Line 2 -- The cross-section shows a general trend of a layer of high resistivity down to a depth of approximately 60 feet. Below that depth is a layer of low resistivity. This is consistent with the boring logs showing the subsurface that was tested to be fine sands and the water table to be at approximately 50 - 60 feet deep. An area of lower resistivity is seen between stations 220 and 270 and coincides with the location of the waste water vaults.

Line 3 – The cross-section shows two low resistivity anomalies which are consistent with the locations of vault 3 and vault 4. The location of the line was not completely centered on these

vaults but the close proximity was sufficient to pick up the influence of the buried vaults. The location of vault 3 is centered at station 38 and the location of vault 4 is centered at station 46.

Line 4 -- The cross-section is located directly above vaults 4, 5, and 1. Areas of low resistivity were detected at each of the coinciding vault locations. Vault 4 is centered at station 22, vault 5 is centered at station 34 and vault 1 is centered station 78. An area of low resistivity was also detected in the middle of the cross-section centered at station 51. The exact cause of this anomaly is unknown, but could indicate groundwater or buried objects.

Line 5 – The cross-section shows low resistivity areas coinciding with the locations of vault 3, vault 4, and vault 5. Vault 3 is centered at station 18 and vaults 3 and 4 together are centered at station 42. Other areas of low resistivity are detected in the cross-section. A low resistivity anomaly, located between stations 60 and 80, is most likely the wastewater lagoon.

Line 6 -- The cross-section shows two low resistivity anomalies which are consistent with the locations of vault 2 and vault 1. The location of the line was not completely centered on these vaults but the close proximity was sufficient to pick up the influence of the buried vaults. The location of vault 2 is centered at station 34 and the location of vault 1 is centered at station 88.

3.0 LIMITATIONS

All geophysical testing methods rely on instrument signals to indicate physical conditions in the field. Signal information can be affected by on-site conditions beyond the control of the operator, such as, but not limited to, cultural features, standing water, high subsurface moisture content, and other buried objects. Interpretation of those signals is based on a combination of known factors combined with the experience of the operator and geophysical scientist evaluating the results. The provided depth measurements are estimations based on an estimation of the electrical properties of the subsurface material.

This report has been prepared for the application discussed and in accordance with generally accepted geophysical practices. No warranties, expressed or implied, are intended or made. The findings presented in this report are based upon the data obtained from the geophysical surveys and from other information discussed in this report. This report does not reflect variations that may occur in areas not tested or inaccessible to the geophysical equipment, across the site, or due to the modifying effects of construction or weather.

4.0 CONCLUSION

The field observations and the geophysical survey results confirm the presence of the waste water vault system. The EMI data delineates the lateral extents of the vault system and confirms the presence of conductive and metallic buried objects. The ERI data confirmed the presence of the waste water lagoon and the four vault systems. Due to the conductive nature of

the vault system the ERI cross-sections may cause the features to appear bigger but the cross-sections indicate the approximate depths and lateral extents of the buried objects. The anomaly locations are displayed on Exhibits 7 and 8. ERI lines 1 and 2 (long lines for deeper penetration) indicated a consistent sandy material beneath the vault system with an interpreted ground water table at an approximate depth of 50 to 60 feet.

We appreciate the opportunity to be of service to you on this project. Please don't hesitate to contact the undersigned, if you may have any questions.

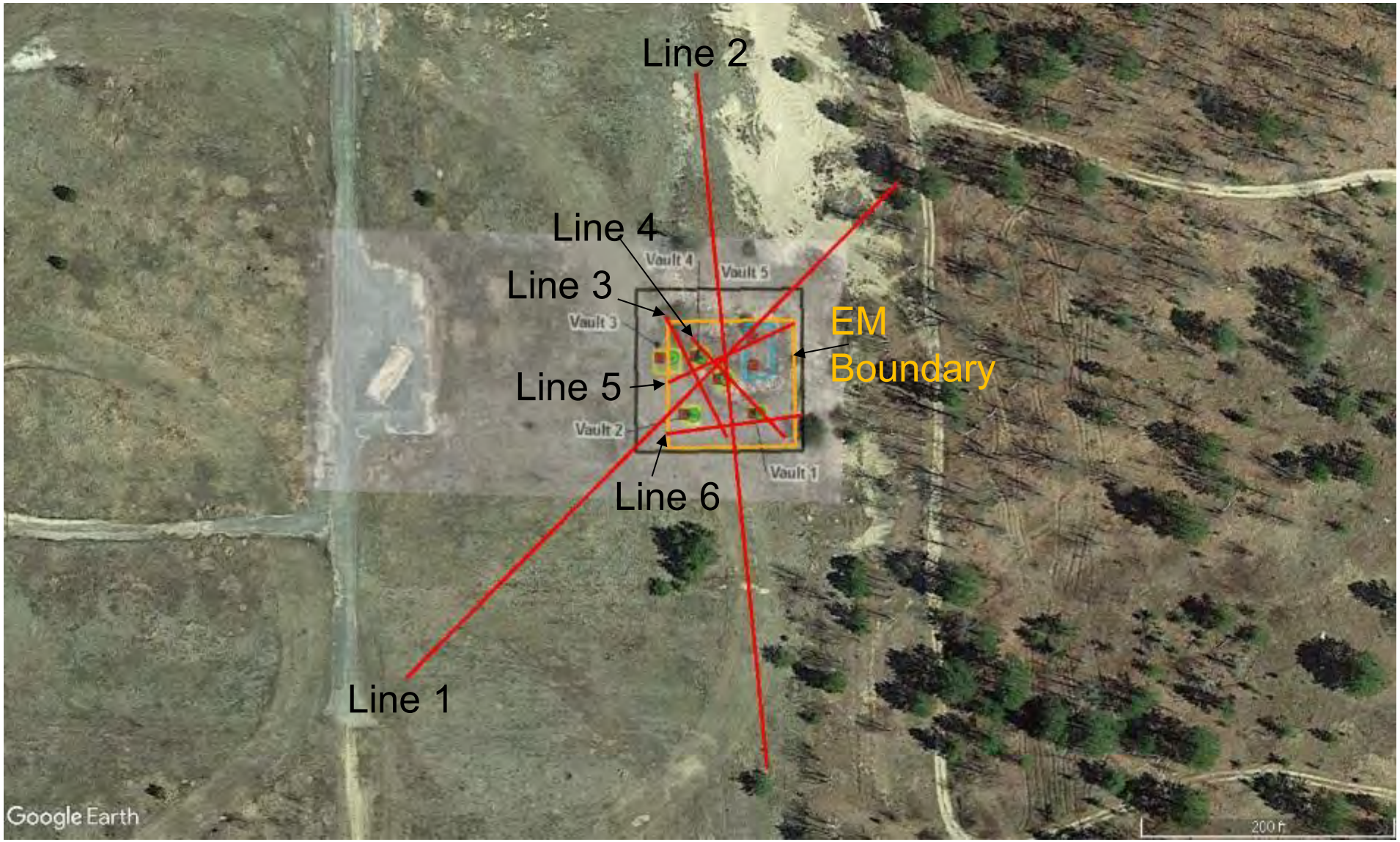
Sincerely,

Terracon Consultants, Inc.

Kyle J. Shalek, Ph.D.
Geophysicist/Senior Staff Geologist
513-612-9139
Kyle.Shalek@terracon.com

Rajan Viswanathan, P.E.
Senior Project Manager

Attachments: Exhibits 1-8



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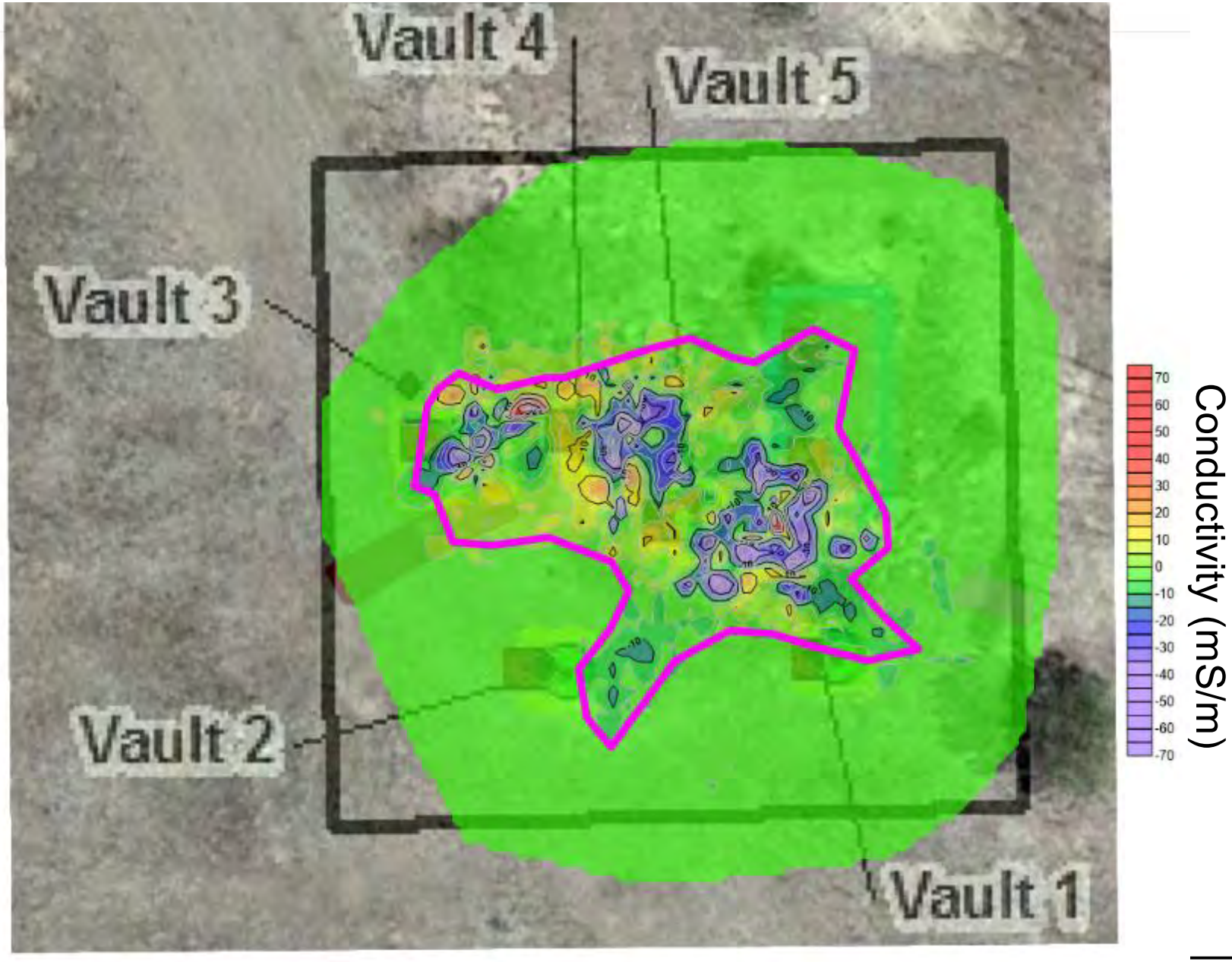
Consulting Engineers & Scientists
611 Lunken Park Dr. Cincinnati, OH
PH. (513) 612-9081 FAX. (513) 321-0294

Site Survey Plan

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit

1



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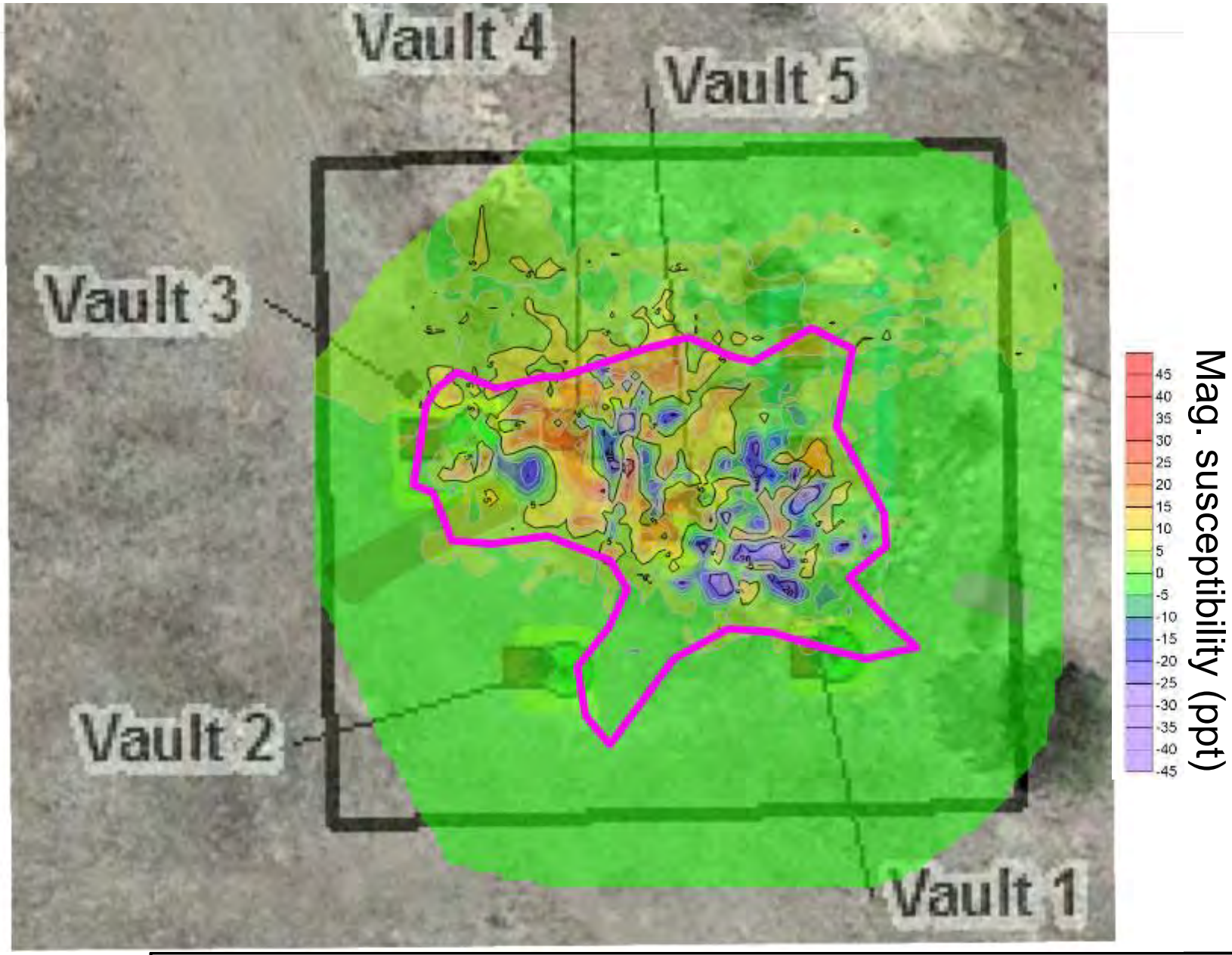
EMI Conductivity Contour Map

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit 2



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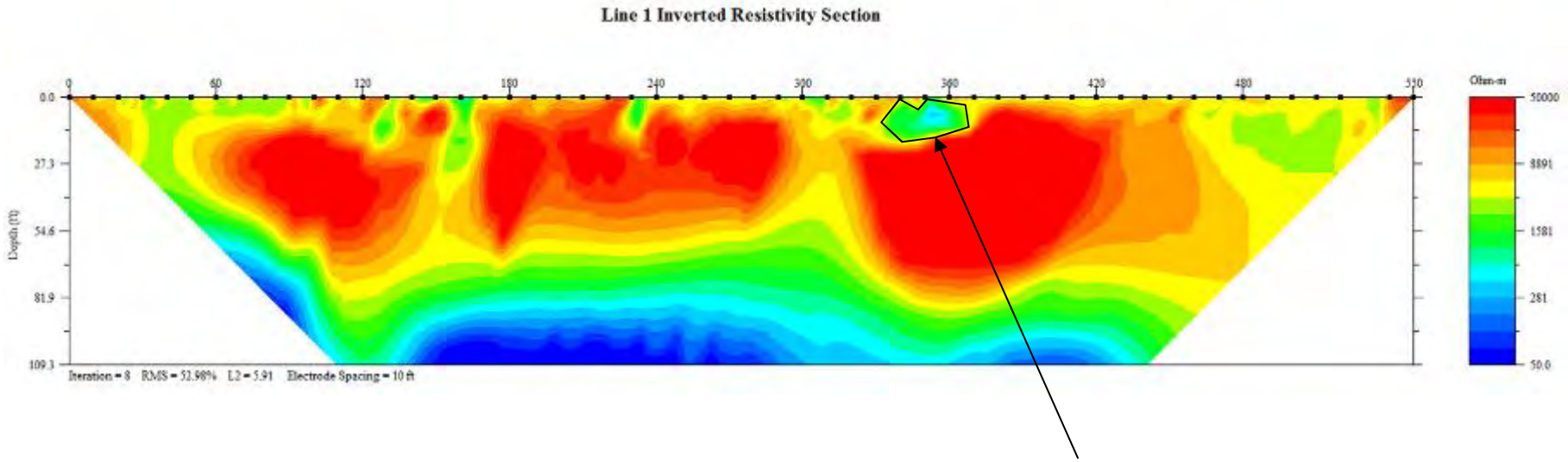
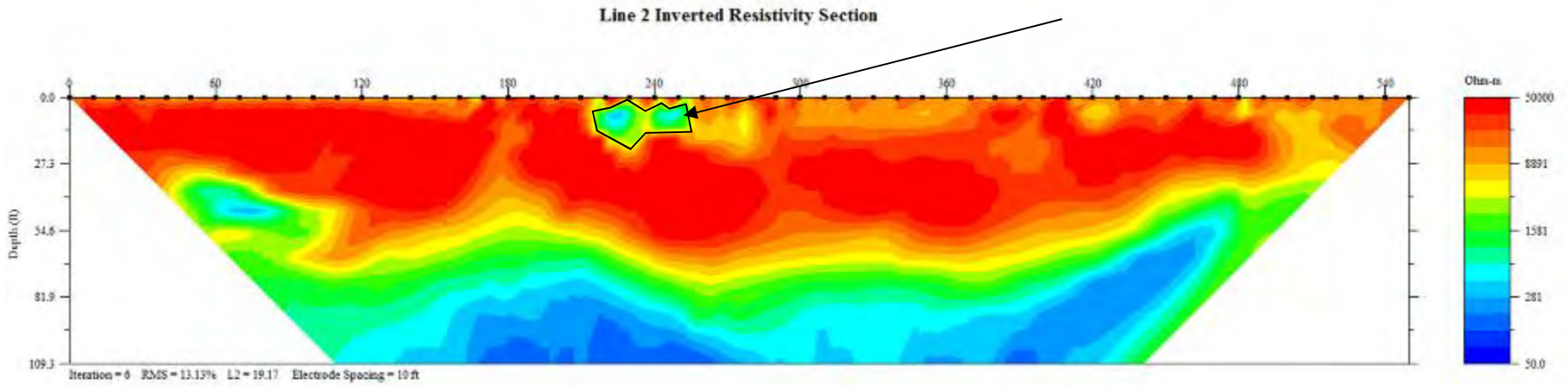
EMI Magnetic Susceptibility Contour Map

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit 3



Area of Waste Water Vaults



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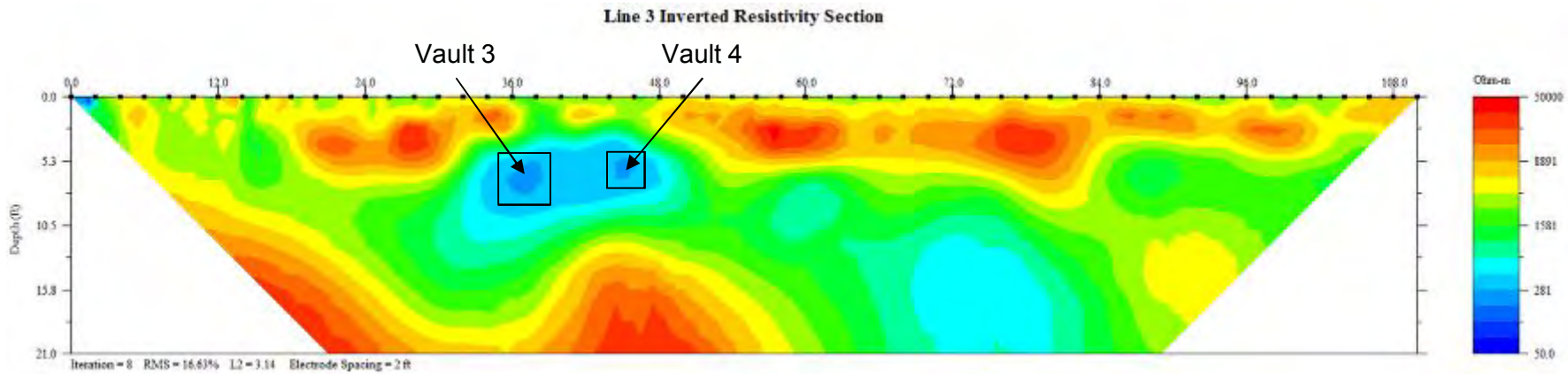
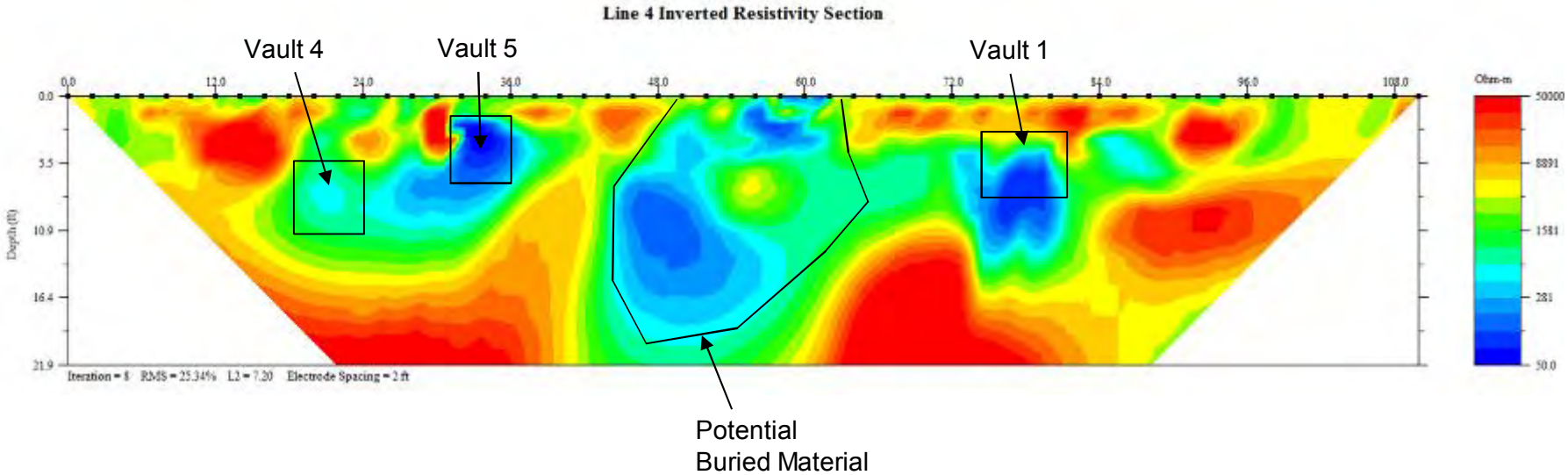
Electrical Resistivity Cross-Sections

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit

4





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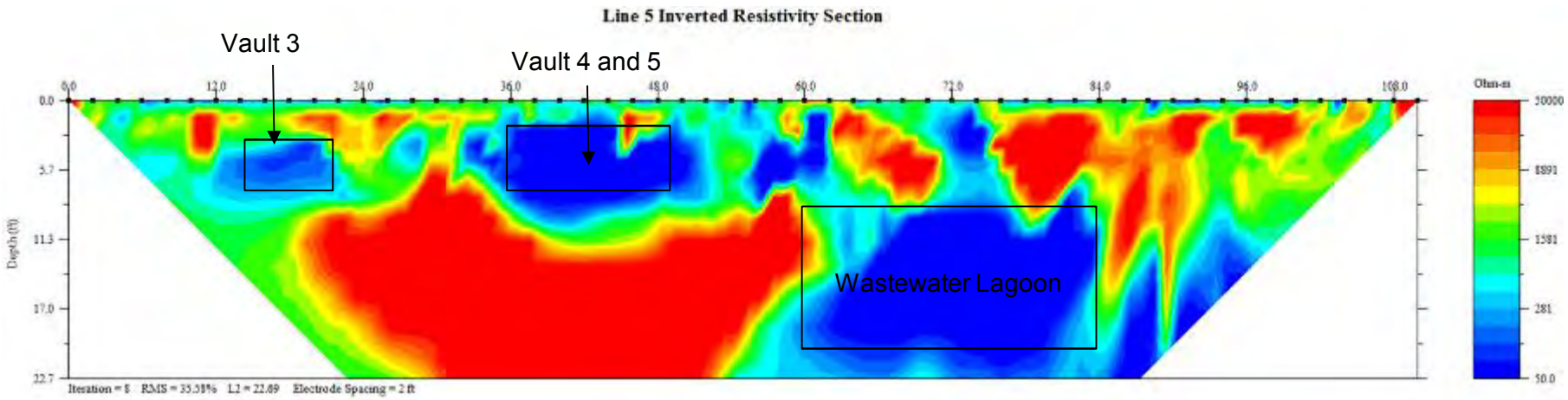
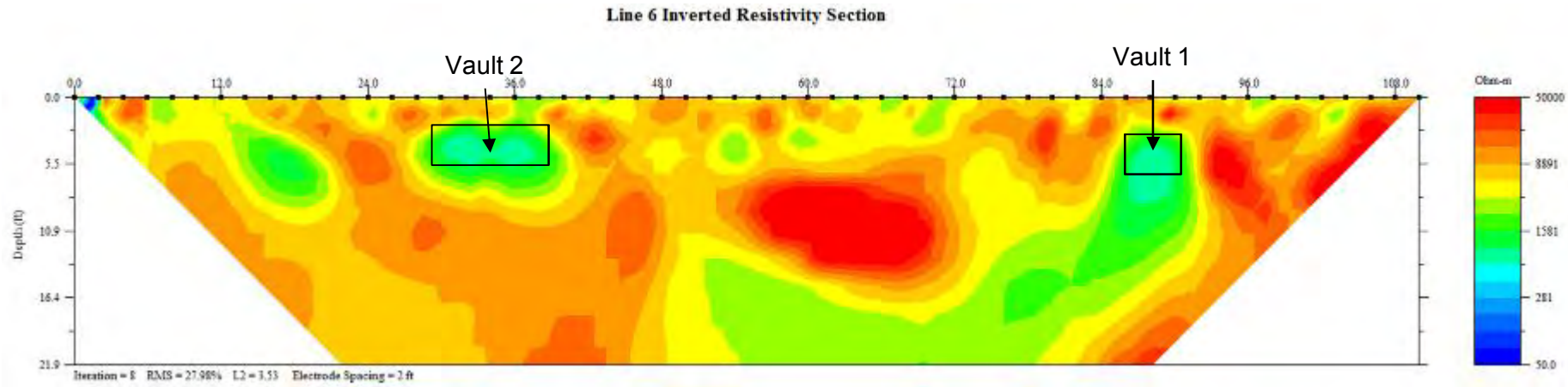
Electrical Resistivity Cross-Sections

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit

5





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Scale: N.T.S.	

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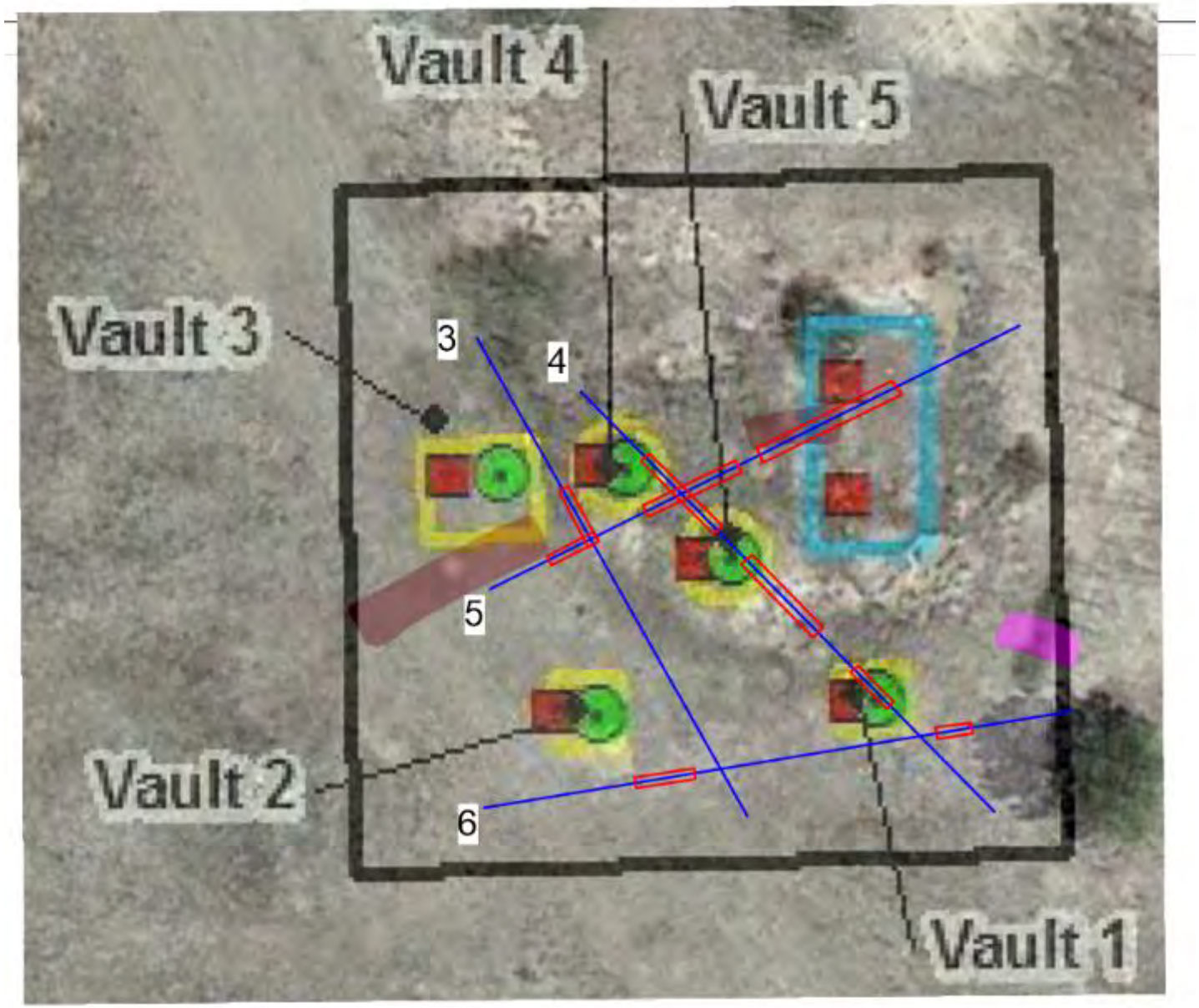
Electrical Resistivity Cross-Sections
Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit
6



N

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project No. N1175197	Date: 9/14/2017
Project Manager: KJS	Drawn by: JCT
File Name: exhibits.pdf	
Scale: N.T.S.	

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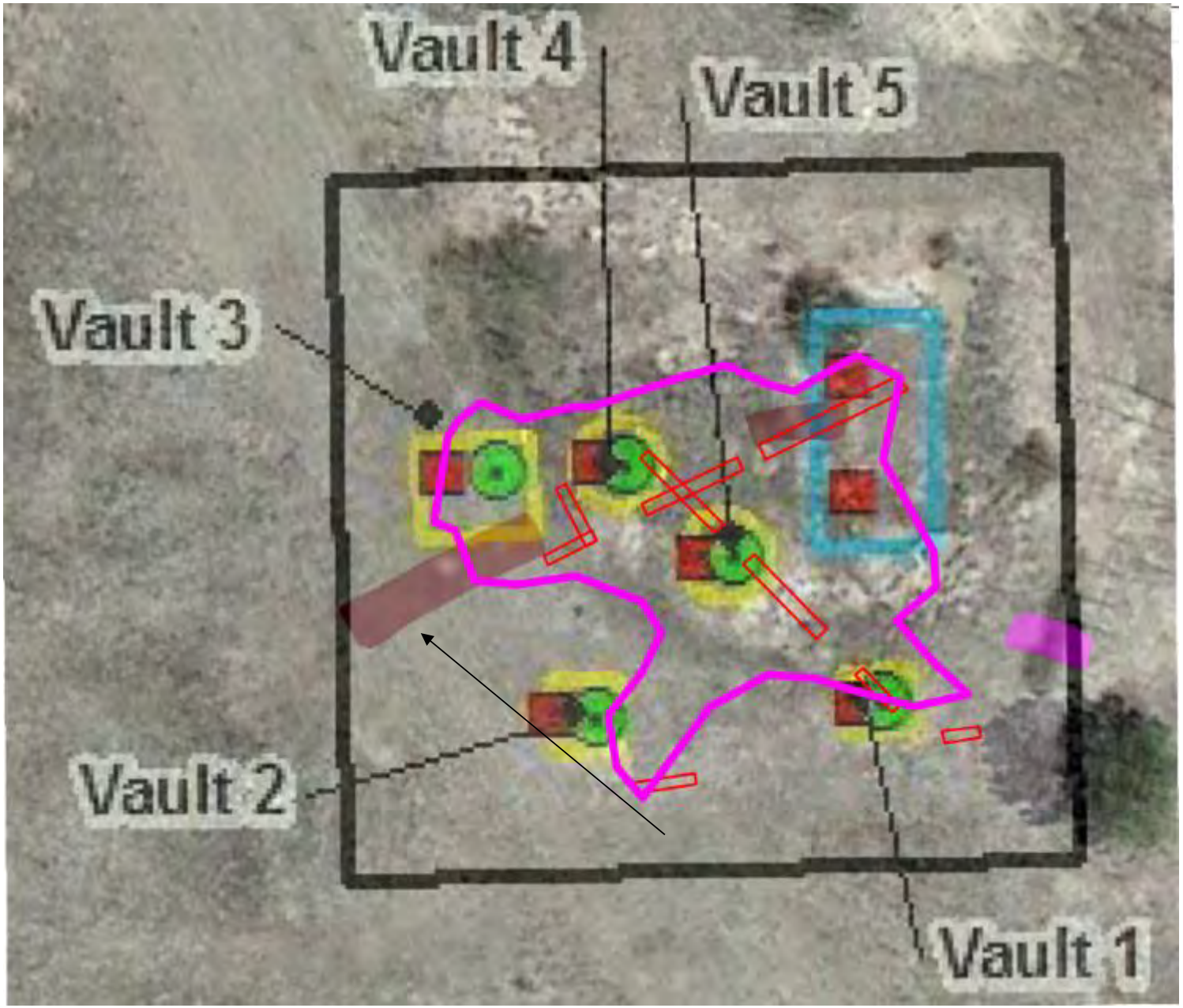
Electrical Resistivity Anomaly Locations

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit

7



N

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project No. N1175197	Date: 9/14/2017
Project Manager: KJS	Drawn by: JCT
File Name: exhibits.pdf	
Scale: N.T.S.	

Terracon
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611 Lunken Park Dr. Cincinnati, OH
PH. (513) 612-9081 FAX. (513) 321-0294

Anomaly Locations

Waste Water Vault System
Raco Field
Brimley, Michigan

Exhibit

8

ATTACHMENT 3: RESULTS OF PASSIVE SOIL GAS SURVEY

BEACON ENVIRONMENTAL SERVICES, INC.

The Leaders in Soil Gas Surveys and Vapor Intrusion Monitoring

GEO Consultants Corporation
325 Kentucky Avenue
Kevil, KY 42053
Attn: Natalie Magill

Passive Soil Gas Survey – Analytical Report
Date: September 11, 2017

Beacon Project No. 3759

Project Reference:	Raco MBA Site, Raco, MI
Samplers Installed:	August 11, 2017
Samplers Retrieved:	August 24, 2017
Samples Received:	August 25, 2017
Analyses Completed:	August 30, 2017
Laboratory Data Issued:	September 1, 2017

EPA Method 8260C
All samples were successfully analyzed using thermal desorption-gas chromatography/mass spectrometry (TD-GC/MS) instrumentation to target a custom compound list following EPA Method 8260C. Laboratory results are reported in nanograms (ng) of specific compound per sample.

Laboratory QA/QC procedures included internal standards, surrogates, and blanks based on EPA Method 8260C. Analyses and reporting were in accordance with BEACON's Quality Assurance Project Plan.

Reporting limits
The reporting limit (RL) is 10 nanograms (ng) for vinyl chloride, trans-1,2-dichloroethene, cis-1,2-dichloroethene, and trichloroethene; and 25 ng for the remaining individual compounds. **Table 1** provides survey results in nanograms per sampler by sample-point number and compound name. For the four (4) compounds listed above, measurements below the limit of quantitation (10 ng) but above the limit of detection (5 ng) are flagged with a "J." The RLs represent a baseline above which results meet laboratory-determined limits of precision and accuracy. Any field sample measurements above the upper calibration standard are estimated; however, these values are reported without qualifiers because all reported measurements are relative to each other and are appropriate to meet the survey objectives of locating source areas and vapor intrusion pathways and defining the lateral extent of contamination.

Calibration Verification
The continuing calibration verification (CCV) values for the calibration check compounds were all within ±20% of the true values as defined by the initial five-point calibration and met the requirements specified in Beacon Environmental's Quality Assurance Project Plan.

Method Blanks/Trip Blanks
Laboratory method blanks are run with each sample batch to identify contamination present in the laboratory. If contamination is detected on a method blank, measurements of identical compounds in that sample batch are flagged in the laboratory report. The laboratory method blanks analyzed in connection with the present samples revealed no contamination.

The trip blank is a sampler prepared, transported, and analyzed with other samples but intentionally not exposed. Any target compounds identified on the trip blanks are reported in the laboratory data. The analyses of the trip blanks (labeled Trip-1 through Trip-4 in **Table 1**) reported none of the targeted compounds.

Passive Soil-Gas Survey Notes

When sample locations are covered with or near the edge of an artificial surface (*e.g.*, asphalt or concrete), the concentrations of compounds in soil gas are often significantly higher than the concentrations would be if the surfacing were not present. Thus, a reading taken below or near an impermeable surface is much higher than it would be in the absence of such a cap. Therefore, the sample location conditions should be evaluated when comparing results between locations.

Survey findings are exclusive to this project and when the spatial relationships are compared with results of other BEACON Surveys it is necessary to incorporate survey and site information from both investigations (*e.g.*, depth to sources, soil types, porosity, soil moisture, presence of impervious surfacing, sample collection times). BEACON recommends the guidelines stated in **Attachment 1** to establish a relationship between reported soil-gas measurements and actual subsurface contaminant concentrations, which will indicate those measurements representing significant subsurface contamination.

BEACON's passive soil-gas samplers are prepared with two sets of adsorbent cartridges for subsequent duplicate or confirmatory sample analysis. At the client's request, duplicate analysis was performed for ten (10) field samples. The field sample duplicates were designated "Dup" following the sample number. When comparing quantitative results, a duplicate correspondence should be considered when the relative percent difference (RPD) between the two samples is less than or equal to 100%. For the purpose of calculating correspondences, all non-detections should be assigned, as a baseline value, the RL for the specific contaminant. Based on these assumptions, a 100% correlation was found between the field sample duplicates and their base samples.

Project Details

Samplers were deployed on August 11, 2017, and were retrieved on August 24, 2017. **Attachment 2** describes standard field procedures. Individual deployment and retrieval times will be found in the Chain of Custody Form (**Attachment 3**).

One hundred (100) field samples, ten (10) field sample duplicates, and four (4) trip blanks were received by BEACON on August 25, 2017. Adsorbent cartridges from the passive samplers were thermally desorbed, then analyzed using gas chromatography/mass spectrometry (GC/MS) equipment, in accordance with EPA Method 8260C, as described in **Attachment 4**. BEACON's laboratory analyzed each sample for the targeted compounds; analyses were completed on August 30, 2017. Following a laboratory review, results were provided on September 1, 2017.

Sample locations are shown on **Figure 1**. The following table lists frequency of detections based on the number of field samples analyzed, the reporting limit, and the maximum value for each mapped compound. The table also includes the interpolation method for the compound distribution maps provided.

Figure No.	**2**	**3**
Compound	Trichloroethene	Toluene
Frequency	3	3
Reporting Limit (nanograms)	10	25
Max Value (nanograms)	13	47
Interpolation Method	Kriging	Kriging

Attachments:

-1- Applying Results From Passive Soil-Gas Surveys
-2- Field Procedures
-3- Chain-of-Custody Form
-4- Laboratory Procedures
5 CLP Summary Data Package

ALL DATA MEET REQUIREMENTS AS SPECIFIED IN THE BEACON ENVIRONMENTAL SERVICES, INC. QUALITY ASSURANCE PROJECT PLAN AND THE RESULTS RELATE ONLY TO THE SAMPLES REPORTED. BEACON ENVIRONMENTAL SERVICES IS ACCREDITED TO ISO/IEC 17025:2005, AND THE WORK PERFORMED WAS IN ACCORDANCE WITH ISO/IEC 17025:2005 REQUIREMENTS, WITH THE EXCEPTION THAT SAMPLES WERE ANALYZED WITHIN A 24-HOUR TUNE WINDOW. THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF THE LABORATORY. RELEASE OF THE DATA CONTAINED IN THIS DATA PACKAGE HAS BEEN AUTHORIZED BY THE LABORATORY DIRECTOR OR HIS SIGNEE, AS VERIFIED BY THE FOLLOWING SIGNATURES:

Steven C. Thornley
Laboratory Director

Patti J. Riggs
Quality Manager

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	LB170828c	Trip-1	Trip-2	Trip-3	Trip-4	SG001
Project Number:		3759	3759	3759	3759	3759
Lab File ID:	C17082803	C17082810	C17082811	C17082812	C17083006	C17082814
Received Date:		8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/30/2017	8/28/2017
Analysis Time:	13:47	16:25	16:47	17:09	15:08	17:53
Matrix:						Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG002	SG003	SG004	SG005	SG006	SG007
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082815	C17082816	C17082817	C17082818	C17082819	C17082820
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/28/2017
Analysis Time:	18:16	18:38	19:00	19:22	19:43	20:05
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG008	SG009	SG010	SG011	SG011-Dup	SG012
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082821	C17082822	C17082823	C17082824	C17082825	C17082826
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/28/2017
Analysis Time:	20:27	20:49	21:11	21:32	21:55	22:17
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	**6 J**	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG013	SG014	SG015	SG016	SG017	SG018
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082827	C17082828	C17082829	C17082830	C17082831	C17082832
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/28/2017	8/28/2017	8/28/2017	8/28/2017	8/29/2017	8/29/2017
Analysis Time:	22:38	23:00	23:22	23:44	0:06	0:27
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG019	SG020	SG021	SG022	SG022-Dup	SG023
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082833	C17082834	C17082835	C17082836	C17082837	C17082838
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	0:49	1:11	1:34	1:56	2:18	2:39
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	**13**	**9 J**	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG024	SG025	SG026	SG027	SG028	SG029
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082839	C17082840	C17082841	C17082842	C17082843	C17082844
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	3:01	3:23	3:45	4:07	4:29	4:51
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	**43**	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG030	SG031	SG032	SG033	SG033-Dup	SG034
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082845	C17082846	C17082847	C17082848	C17082849	C17082850
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	5:13	5:35	5:57	6:19	6:41	7:03
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG035	SG035-Dup	SG036	SG037	SG038	SG039
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082851	C17082852	C17082853	C17082854	C17082855	C17082856
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	7:24	7:46	8:08	8:30	8:53	9:14
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG040	SG041	SG042	SG043	SG044	SG044-Dup
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082857	C17082858	C17082859	C17082860	C17082861	C17082862
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	9:36	9:58	10:20	10:43	11:04	11:26
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG045	SG046	LB170829c	SG047	SG048	SG049
Project Number:	3759	3759		3759	3759	3759
Lab File ID:	C17082863	C17082864	C17082903	C17082906	C17082907	C17082908
Received Date:	8/25/2017	8/25/2017		8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	11:48	12:10	13:46	14:52	15:14	15:36
Matrix:	Soil Gas	Soil Gas		Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG050	SG051	SG052	SG053	SG054	SG055
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082909	C17082910	C17082911	C17082912	C17082913	C17082914
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	15:58	16:20	16:42	17:03	17:25	17:47
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG055-Dup	SG056	SG057	SG058	SG059	SG060
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082915	C17082916	C17082917	C17082918	C17082919	C17082920
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	18:09	18:31	18:53	19:15	19:37	19:59
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG061	SG062	SG063	SG064	SG065	SG066
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082921	C17082922	C17082923	C17082924	C17082925	C17082926
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017
Analysis Time:	20:20	20:42	21:04	21:26	21:48	22:10
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	**47**	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG066-Dup	SG067	SG068	SG069	SG070	SG071
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082927	C17082928	C17082929	C17082930	C17082931	C17082932
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/29/2017	8/30/2017
Analysis Time:	22:32	22:54	23:16	23:38	23:59	0:21
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG072	SG073	SG074	SG075	SG076	SG077
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082933	C17082934	C17082935	C17082936	C17082937	C17082938
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	0:43	1:05	1:27	1:49	2:11	2:33
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG077-Dup	SG078	SG079	SG080	SG081	SG082
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082939	C17082940	C17082941	C17082942	C17082943	C17082944
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	2:55	3:16	3:38	4:00	4:22	4:44
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	**45**	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG083	SG084	SG085	SG086	SG087	SG088
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082945	C17082946	C17082947	C17082948	C17082949	C17082950
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	5:06	5:28	5:50	6:12	6:34	6:55
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG088-Dup	SG089	SG090	SG091	SG092	SG093
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082951	C17082952	C17082953	C17082954	C17082955	C17082956
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	7:17	7:39	8:01	8:22	8:45	9:07
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	**10 J**	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG094	SG095	SG096	SG097	SG098	SG099
Project Number:	3759	3759	3759	3759	3759	3759
Lab File ID:	C17082957	C17082958	C17082959	C17082960	C17082961	C17082962
Received Date:	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017	8/25/2017
Analysis Date:	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	9:28	9:51	10:12	10:34	10:56	11:18
Matrix:	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas	Soil Gas
Units:	ng	ng	ng	ng	ng	ng
COMPOUNDS						
Vinyl Chloride	<10	<10	<10	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10	<10	<10	<10
Benzene	<25	<25	<25	<25	<25	<25
Trichloroethene	<10	<10	<10	<10	<10	<10
Toluene	<25	<25	<25	<25	<25	<25
Ethylbenzene	<25	<25	<25	<25	<25	<25
p & m-Xylene	<25	<25	<25	<25	<25	<25
o-Xylene	<25	<25	<25	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

Table 1

Beacon Environmental Services, Inc.
2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA

Analysis by EPA Method 8260C

Client Sample ID:	SG099-Dup	SG100	LB170830c
Project Number:	3759	3759	
Lab File ID:	C17082963	C17082964	C17083003
Received Date:	8/25/2017	8/25/2017	
Analysis Date:	8/30/2017	8/30/2017	8/30/2017
Analysis Time:	11:40	12:02	14:02
Matrix:	Soil Gas	Soil Gas	
Units:	ng	ng	ng
COMPOUNDS			
Vinyl Chloride	<10	<10	<10
trans-1,2-Dichloroethene	<10	<10	<10
cis-1,2-Dichloroethene	<10	<10	<10
Benzene	<25	<25	<25
Trichloroethene	<10	<10	<10
Toluene	<25	<25	<25
Ethylbenzene	<25	<25	<25
p & m-Xylene	<25	<25	<25
o-Xylene	<25	<25	<25

Results in nanograms (ng). J = Values below limit of quantitation (LOQ) but above limit of detection (LOD). B = Detected in method blank.

BEACON ENVIRONMENTAL SERVICES, INC.
2203A Commerce Road, Suite 1, Forest Hill, MD 21050 USA
www.Beacon-USA.com 1-410-838-8780
Beacon Project No. 3759, September 2017

LEGEND

SG008 PASSIVE SOIL-GAS SAMPLE LOCATION

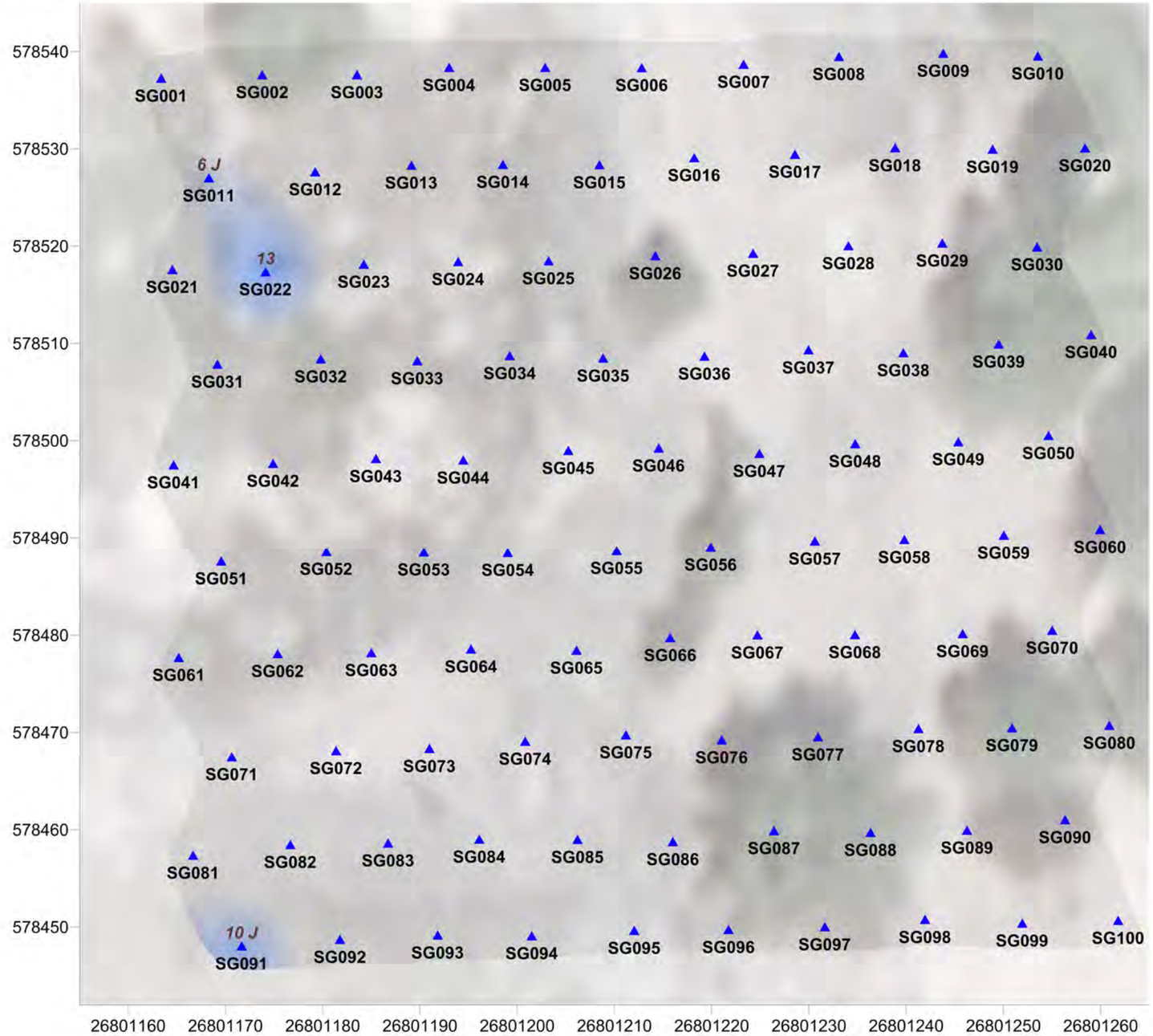
Scale in Feet

0 12.5 25

System: State Plane Michigan North
Datum: NAVD-88
Coordinate Units: International Feet

Figure 1
Passive Soil-Gas Survey
Sample Locations

Raco MBA Site
Raco, MI



BEACON ENVIRONMENTAL SERVICES, INC.
2203A Commerce Road, Suite 1, Forest Hill, MD 21050 USA
www.Beacon-USA.com 1-410-838-8780
Beacon Project No. 3759, September 2017

LEGEND

8 J NANOGRAMS/SAMPLER (J = Estimated value)

SG008 PASSIVE SOIL-GAS SAMPLE LOCATION

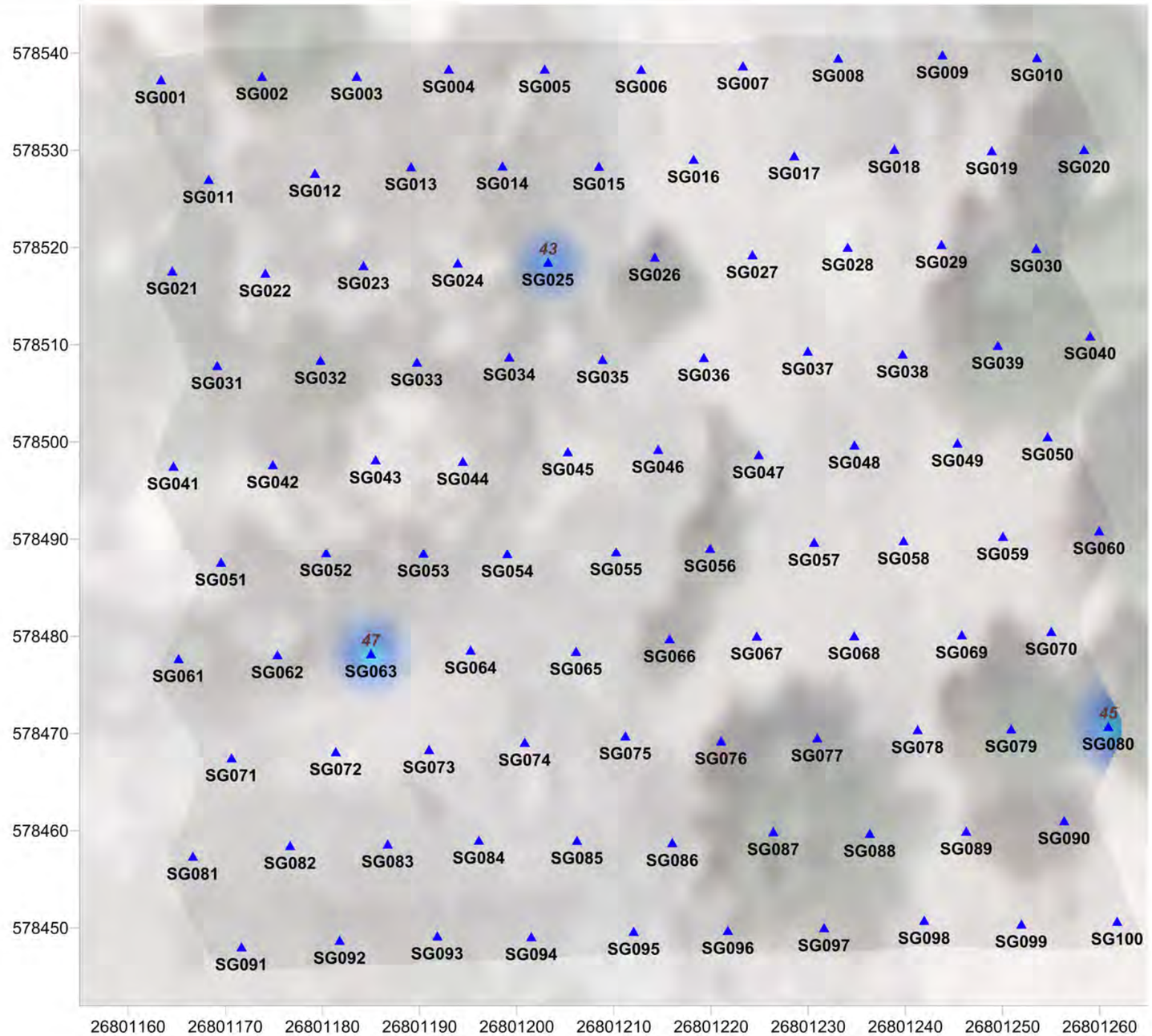
Scale in Feet

0 12.5 25

System: State Plane Michigan North
Datum: NAVD-88
Coordinate Units: International Feet

Figure 2
Passive Soil-Gas Survey
Trichloroethene

Raco MBA Site
Raco, MI



BEACON ENVIRONMENTAL SERVICES, INC.

2203A Commerce Road, Suite 1, Forest Hill, MD 21050 USA
www.Beacon-USA.com 1-410-838-8780
Beacon Project No. 3759, September 2017

LEGEND

1,000 NANOGRAMS/SAMPLER

▲ SG008 PASSIVE SOIL-GAS SAMPLE LOCATION

Scale in Feet

0 12.5 25

System: State Plane Michigan North
Datum: NAVD-88
Coordinate Units: International Feet

Figure 3
Passive Soil-Gas Survey
Toluene

Raco MBA Site
Raco, MI

Attachments

Attachment 1

APPLYING RESULTS FROM PASSIVE SOIL-GAS SURVEYS

The utility of soil-gas surveys is directly proportional to their accuracy in reflecting and representing changes in the subsurface concentrations of source compounds. Passive soil-gas survey results are the mass collected from the vapor-phase emanating from the source(s). The vapor-phase is merely a fractional trace of the source(s) and, as a matter of convenience, the units used in reporting detection values from passive soil-gas surveys are smaller than those employed for source-compound concentrations.

Passive soil gas data are reported in mass of compounds identified per sample location (e.g., nanograms (ng) or micrograms (µg) per sampler). Results from a passive soil gas survey typically are then used to guide where follow-on intrusive samples should be collected to obtain corresponding concentrations of the contaminants in soil, soil gas, and/or groundwater, as well as eliminate those areas where intrusive samples are not required. It is not practical to report passive soil gas data as concentration because the sampler's uptake rates of the compounds are often greater than the replenishment rates of the compounds around the sampler, which results in low bias measurements, and the replenishment rates will be dependent on several factors that include, at a minimum, soil gas concentrations, soil porosity and permeability, and soil moisture level.

Whatever the relative concentrations of source and associated soil gas, best results are realized when the ratio of soil-gas measurements to actual subsurface concentrations remains as close to constant as the real world permits. It is the reliability and consistency of this ratio, not the particular units of mass (*e.g.*, nanograms) that determine usefulness. Thus, BEACON emphasizes the necessity of conducting — at minimum — follow-on intrusive sampling in areas that show relatively high soil-gas measurements to obtain corresponding concentrations of soil and groundwater contaminants. These correspondent values furnish the basis for approximating a relationship. For extrapolating passive soil gas results to vapor intrusion evaluations, we recommend a minimum of three passive soil gas locations be converted to a shallow vapor well then sampled using an active soil gas method. Once a relationship is established, it can be used in conjunction with the remaining soil-gas measurements to estimate subsurface contaminant concentrations across the survey field. (See www.beacon-usa.com/passivesoilgas.html, Publication 1: *Mass to Concentration Tie-In for PSG Surveys* and Publication 4: *Groundwater and PSG Correlation*.) It is important to keep in mind, however, that specific conditions at individual sample points, including soil porosity and permeability, depth to contamination, and perched ground water, can have an impact on soil-gas measurements at those locations.

When passive soil-gas surveys are utilized as described above, the data provide information that can yield substantial savings in drilling costs and in time. They furnish, among other things, a checklist of compounds expected at each survey location and help to determine how and where drilling budgets can most effectively be spent. Passive soil-gas surveys can also be used as a remediation or general site monitoring tool that can be implemented on a quarterly, semi-annual or annual basis.

Attachment 2

FIELD PROCEDURES FOR PASSIVE SOIL-GAS SURVEYS

The following field procedures are routinely used during a BEACON Passive Soil-Gas Survey. Modifications can be and are incorporated from time to time in response to individual project requirements. In all instances, BEACON adheres to EPA-approved Quality Assurance and Quality Control practices.

A. Field personnel carry a BESURE Sample Collection Kit™ and support equipment to the site and deploy the passive samplers in a prearranged survey pattern. A passive sampler consists of a borosilicate glass vial containing hydrophobic adsorbent cartridges with a length of wire attached to the vial for retrieval. Although samplers require only one person for emplacement and retrieval, the specific number of field personnel required depends upon the scope and schedule of the project. Each Sampler emplacement generally takes less than two minutes.

B. At each survey point a field technician clears vegetation as needed and, using a hammer drill with a 1″- to 1½″-diameter bit, creates a hole 12 to 14 inches deep. [Note: For locations covered with asphalt, concrete, or gravel surfacing, the field technician drills a 1″- to 1½″-diameter hole through the surfacing to the soils beneath]. The technician then, using a hammer drill with a ½″ diameter bit, creates a hole three-feet deep. The hole is then sleeved with a 1″-diameter metal sleeve.

C. The technician then removes the solid plastic cap from a sampler and replaces it with a Sampling Cap (a plastic cap with a hole covered by screen meshing). The technician inserts the sampler, with the Sampling Cap end facing down, into the hole (**see attached figure**). The sampler is then covered with an aluminum foil plug and soils for uncapped locations or, for capped locations, an aluminum foil plug and a concrete patch. The sampler's location, time and date of emplacement, and other relevant information are recorded on the Field Deployment Form.

D. One or more trip blanks are included as part of the quality-control procedures.

E. Once all the samplers have been deployed, field personnel schedule sampler recovery and depart, taking all other equipment and materials with them.

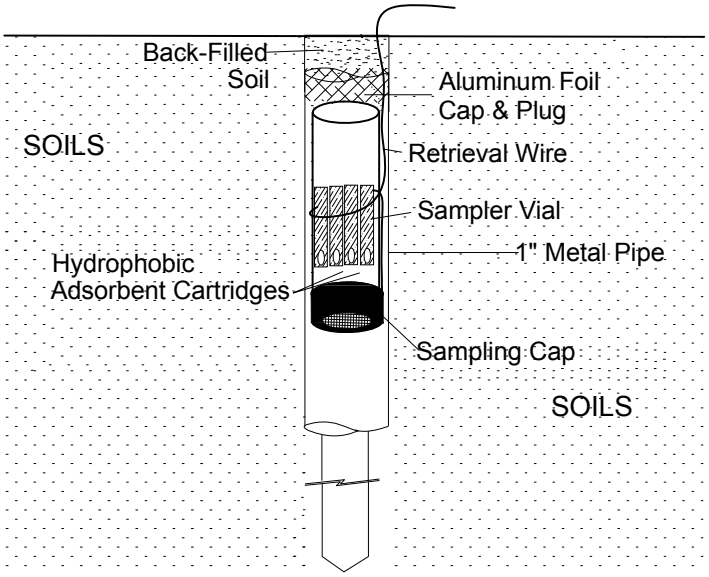
F. Field personnel retrieve the samplers at the end of the exposure period. At each location, a field technician withdraws the sampler from its hole, removes the retrieval wire, and wipes the outside of the vial clean using gauze cloth; following removal of the Sampling Cap, the threads of the vial are also cleaned. A solid plastic cap is screwed onto the vial and the sample location number is written on the label. The technician then records sample-point location, date, time, etc. on the Field Deployment Form.

G. Sampling holes are refilled with soil, sand, or other suitable material. If samplers have been installed through asphalt or concrete, the hole is filled to grade with a plug of cold patch or cement.

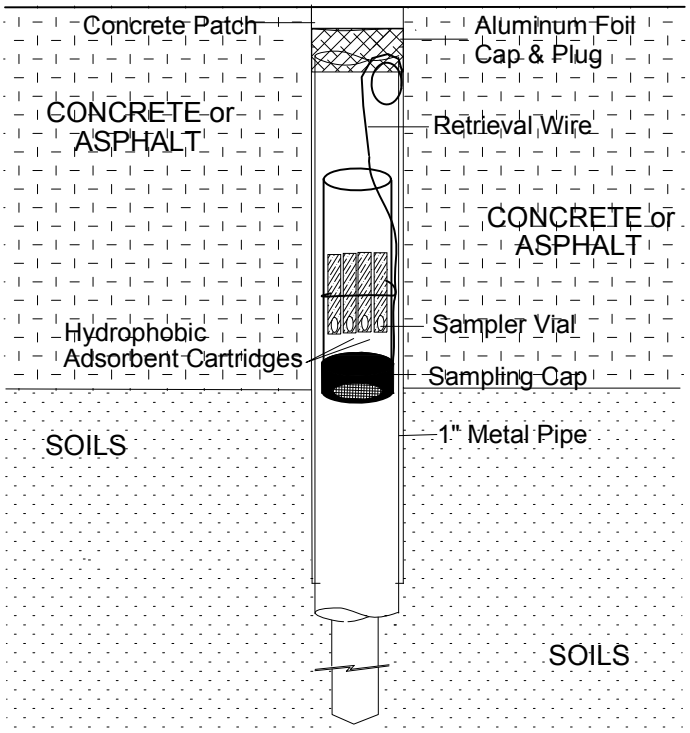
H. Following retrieval, field personnel ship or transport the passive samplers to BEACON's laboratory.

BEACON'S PASSIVE SOIL-GAS SAMPLER

DEPLOYMENT THROUGH SOILS



DEPLOYMENT THROUGH AN ASPHALT/CONCRETE CAP



Attachment 3

Chain of Custody Form

BEACON ENVIRONMENTAL SERVICES, INC

CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA
P: 1-410-838-8780 | F: 1-410-838-8740

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	☒ Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced 8/11/2017	Date Retrieved 8/24/2017	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
	Time Emplaced	Time Retrieved			
SG001	0908	1107	36	Soil	
SG002	0902	1109	36	Soil	
SG003	0900	1112	36	Soil	
SG004	0858	~~1116~~ 1125	36	Soil	
SG005	0856	~~1118~~ 1116	36	Soil	
SG006	0853	~~1120~~ 1118	36	Soil	
SG007	0850	1120	36	Soil	
SG008	0847	1123	36	Soil	
SG009	0845	1129	36	Soil	
SG010	0844	1132	36	Soil	
SG011	0911	1046	36	Soil	
SG011DUP	0911	1046	36	Soil	DUPLICATE
SG012	0914	1048	36	Soil	
SG013	0916	1050	36	Soil	
SG014	0918	1051	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magee	8/24/17 1218	Fedex	Augusto Benavides	8/25/17 11:07

BEACON ENVIRONMENTAL SERVICES, INC

2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA
P: 1-410-838-8780 | F: 1-410-838-8740

CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	Expedited Turnaround Time
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	☒ Rush (Specify): 5 Days
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced	Date Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
	8/11/2017	8/24/2017			
	Time Emplaced	Time Retrieved			
SG015	0922	1053	36	Soil	
SG016	0924	1055	36	Soil	
SG017	0926	1057	36	Soil	
SG018	0928	1059	36	Soil	
SG019	0930	1102	36	Soil	
SG020	0931	1106	36	Soil	
SG021	0955	1031	36	Soil	
SG022	0952	1032	36	Soil	
SG022DUP	0952	1032	36	Soil	DUPLICATE
SG023	0950	1034	36	Soil	
SG024	0948	0804	36	Soil	
SG025	0946	0807	36	Soil	
SG026	0944	1036	36	Soil	
SG027	0941	1038	36	Soil	
SG028	0939	1039	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magill	8/24/17 1218	FedEx	August Bevovidy	8/25/17 11:04

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CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	[X] Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced 8/11/2017 Time Emplaced	Date Retrieved 8/24/2017 Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/ Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
SG029	0937	1042	36	Soil	
SG030	0935	1045	36	Soil	
SG031	1001	1020	36	Soil	
SG032	1004	1021	36	Soil	
SG033	1006	0812	36	Soil	
SG033DUP	1006	0812	36	Soil	DUPLICATE
SG034	1008	0810	36	Soil	
SG035	1010	0808	36	Soil	
SG035DUP	1010	0808	36	Soil	DUPLICATE
SG036	1014	1023	36	Soil	
SG037	1017	1024	36	Soil	
SG038	1019	1026	36	Soil	
SG039	1022	1027	36	Soil	
SG040	1025	1029	36	Soil	
SG041	1028	1008	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magill	8/24/17 1218	FedEx	Augusto Benavidez	8/25/17 11:07

BEACON ENVIRONMENTAL SERVICES, INC

CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

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Forest Hill, MD 21050 USA
P: 1-410-838-8780 | F: 1-410-838-8740

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	[X] Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced 08/11/2017 / Time Emplaced	Date Retrieved 08/24/2017 / Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
SG042	1030	1010	36	Soil	
SG043	1032	1011	36	Soil	
SG044	1034	0813	36	Soil	
SG044DUP	1034	0813	36	Soil	DUPLICATE
SG045	1036	0815	36	Soil	
SG046	1038	0816	36	Soil	
SG047	1041	1012	36	Soil	
SG048	1043	1015	36	Soil	
SG049	1046	1017	36	Soil	
SG050	1050	1018	36	Soil	
SG051	1227	0956	36	Soil	
SG052	1230	0957	36	Soil	
SG053	1232	0958	36	Soil	
SG054	1234	0959	36	Soil	
SG055	1236	1000	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magill	8/24/17 1218	FedEx	Augusto Bernardi	8/25/17 11:07

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CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	☒ Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced 08/11/2017 / Time Emplaced	Date Retrieved 08/24/2017 / Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
SG055DUP	1236	1000	36	Soil	DUPLICATE
SG056	1238	1001	36	Soil	
SG057	1241	1002	36	Soil	
SG058	1244	1004	36	Soil	
SG059	1246	1005	36	Soil	
SG060	1248	1007	36	Soil	
SG061	1251	0937	36	Soil	
SG062	1253	0912	36	Soil	
SG063	1255	0939	36	Soil	
SG064	1258	0941	36	Soil	
SG065	1300	0943	36	Soil	
SG066	1302	0945	36	Soil	
SG066DUP	1302	0945	36	Soil	DUPLICATE
SG067	1304	0947	36	Soil	
SG068	1306	0949	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? Y N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magill	8/24/17 12:18	FedEx	Augusto Renaudy	8/25/17 11:07

BEACON ENVIRONMENTAL SERVICES, INC

CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

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Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	☒ Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced / Time Emplaced	Date Retrieved / Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
	08/11/2017	08/24/2017			
SG069	1309	0952	36	Soil	
SG070	1312	0953	36	Soil	
SG071	1313	0903	36	Soil	
SG072	1315	~~0912~~ 0915	36	Soil	
SG073	1317	0916	36	Soil	
SG074	1319	0918	36	Soil	
SG075	1321	0919	36	Soil	
SG076	1322	0921	36	Soil	
SG077	1323	0924	36	Soil	
SG077DUP	1323	0924	36	Soil	DUPLICATE
SG078	1325	0925	36	Soil	
SG079	1327	0927	36	Soil	
SG080	1328	0931	36	Soil	
SG081	1330	0901	36	Soil	
SG082	1331	0900	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Magill	8/24/17 1218	FedEx	Augusto Benavides	8/25/17 11:07

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CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	[X] Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced 08/11/2017 / Time Emplaced	Date Retrieved 08/24/2017 / Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
SG083	1333	0858	36	Soil	
SG084	1336	0855	36	Soil	
SG085	1337	0854	36	Soil	
SG086	1338	0853	36	Soil	
SG087	1339	0850	36	Soil	
SG088	1341	0847	36	Soil	
SG088DUP	1341	0847	36	Soil	DUPLICATE
SG089	1342	0846	36	Soil	
SG090	1343	0844	36	Soil	
SG091	1345	0823	36	Soil	
SG092	1346	0824	36	Soil	
SG093	1346	0826	36	Soil	
SG094	1347	0828	36	Soil	
SG095	1348	0833	36	Soil	
SG096	1348	0835	36	Soil	

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # ~~0679~~ 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Nagell	8/24/17 1218	FedEx	August Blevins	8/25/17 11:07

BEACON ENVIRONMENTAL SERVICES, INC

CHAIN-OF-CUSTODY
PASSIVE SOIL-GAS SAMPLES

2203A Commerce Road, Suite 1
Forest Hill, MD 21050 USA
P: 1-410-838-8780 | F: 1-410-838-8740

Project Information		Client Information		
Beacon Project No.:	3759	Company Name:	GEO Consultants	Client PO No.: 17-214
Site Name:	Raco	Office Location:	325 Kentucky Ave, Kevil, KY 42053	
Site Location	Brimley, MI	Samples Submitted By:	Ramsey Ferguson	Expedited Turnaround Time
Analytical Method:	U.S. EPA Method 8260C	Contact Phone No.:	270-205-9725	☒ Rush (Specify): 5 Days
Target Compounds:	TCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, toluene, ethylbenzene, xylenes			

Field Sample ID	Date Emplaced / Time Emplaced	Date Retrieved / Time Retrieved	Sampling Hole Depth (inches)	Type of Surface (Soil/Asphalt/Concrete/Gravel)	Optional Sample Information (e.g., Description of Sample Location, Sample Condition, PID/FID Readings)
	08/11/2017	08/24/2017			
SG097	1349	0836	36	Soil	
SG098	1350	0838	36	Soil	
SG099	1352	0840	36	Soil	
SG099DUP	1352	0840	36	Soil	DUPLICATE
SG100	1353	0842	36	Soil	
SGTB1	—	0745	—	Soil	TRIP BLANK
SGTB2	—	0745	—	Soil	TRIP BLANK
SGTB3	—	0745	—	Soil	TRIP BLANK
SGTB4	—	0745	—	Soil	TRIP BLANK

NM 8/24/17

Special Notes/Instructions:

Shipment of Field Kit to Laboratory - Custody Seal # 0679147 Intact? (Y) N

Relinquished By:	Date/Time	Courier	Received By:	Date/Time
Natalie Mazzo	8/24/17 1218	FedEx	Augusto Bernardez	8/25/17 11:07

Attachment 4

LABORATORY PROCEDURES FOR PASSIVE SOIL-GAS SAMPLES

Following are laboratory procedures used with BEACON Passive Soil-Gas Surveys, a screening technology for expedited site investigation. After exposure, adsorbent cartridges from the passive samplers are analyzed using U.S. EPA Method 8260C as a guidance document, a capillary gas chromatographic/mass spectrometric method, modified to accommodate high temperature thermal desorption of the adsorbent cartridges and to meet the objectives of reporting semi-quantitative data. This procedure is summarized as follows:

A. The adsorbent cartridges are loaded with internal standards and surrogates prior to loading the autosampler with the cartridges. The loaded cartridges are purged in a helium flow. Then the cartridges are thermally desorbed in a helium flow onto a focusing trap. Any analytes in the helium stream are adsorbed onto a focusing trap.

B. Following trap focusing, the trap is thermally desorbed onto a Rxi-624Sil MS 20m, 0.18 mm ID, 1.00 micron film thickness capillary column.

C. The GC/MS is scanned between 35 and 300 Atomic Mass Units (AMU) at 3.12 scans per second.

D. BFB tuning criteria and the initial five-point calibration procedures are those stated in method SW846-8260C. System performance and calibration check criteria are met prior to analysis of samples. A laboratory method blank is analyzed after the daily standard to determine that the system is contaminant-free.

E. The instrumentation used for these analyses includes:

- Agilent 7890-5975c Gas Chromatograph/Mass Spectrometer;
- Markes Unity2 thermal desorber;
- Markes UltrA2 autosampler; and
- Markes Mass Flow Controller Modules.

Attachment 5

CLP Summary Data Package

COVER PAGE - VOLATILE ANALYSIS DATA PACKAGE

Lab Name: Beacon Environmental Services, Inc. **Contract:** W91237-15-D-0011/CY02

Lab Code: BEACON **Case No.:** **SAS No.:** 1131 **SDG No.:** 3759.17.08.25

Method Type: 8260C

Lab Sample ID	Client Sample ID	QC Description
CALV170504C	calv170504c	Calibration Verification
MB170504C	mb170504c	Method Blank
LCS170828C	LCS170828c	Continuing Calibration/Laboratory Control Sample
LB170828C	LB170828c	Method Blank
LCSD170828C	LCSD170828c	Laboratory Control Sample Duplicate
3759 TRIP-1	Trip-1	
3759 TRIP-2	Trip-2	
3759 TRIP-3	Trip-3	
3759 SG001	SG001	
3759 SG002	SG002	
3759 SG003	SG003	
3759 SG004	SG004	
3759 SG005	SG005	
3759 SG006	SG006	
3759 SG007	SG007	
3759 SG008	SG008	
3759 SG009	SG009	
3759 SG010	SG010	
3759 SG011	SG011	
3759 SG011DUP	SG011-Dup	Field Sample Duplicate
3759 SG012	SG012	
3759 SG013	SG013	
3759 SG014	SG014	
3759 SG015	SG015	
3759 SG016	SG016	
3759 SG017	SG017	
3759 SG018	SG018	
3759 SG019	SG019	

Comments:

Signature: **Name:** Steven Thornley

Date: **Title:** Laboratory Director

COVER PAGE - VOLATILE ANALYSIS DATA PACKAGE

Lab Name: Beacon Environmental Services, Inc. **Contract:** W91237-15-D-0011/CY02

Lab Code: BEACON **Case No.:** **SAS No.:** 1131 **SDG No.:** 3759.17.08.25

Method Type: 8260C

Lab Sample ID	Client Sample ID	QC Description
3759 SG020	SG020	
3759 SG021	SG021	
3759 SG022	SG022	
3759 SG022DUP	SG022-Dup	Field Sample Duplicate
3759 SG023	SG023	
3759 SG024	SG024	
3759 SG025	SG025	
3759 SG026	SG026	
3759 SG027	SG027	
3759 SG028	SG028	
3759 SG029	SG029	
3759 SG030	SG030	
3759 SG031	SG031	
3759 SG032	SG032	
3759 SG033	SG033	
3759 SG033DUP	SG033-Dup	Field Sample Duplicate
3759 SG034	SG034	
3759 SG035	SG035	
3759 SG035DUP	SG035-Dup	Field Sample Duplicate
3759 SG036	SG036	
3759 SG037	SG037	
3759 SG038	SG038	
3759 SG039	SG039	
3759 SG040	SG040	
3759 SG041	SG041	
3759 SG042	SG042	
3759 SG043	SG043	
3759 SG044	SG044	

Comments:

Signature: **Name:** Steven Thornley

Date: **Title:** Laboratory Director

COVER PAGE - VOLATILE ANALYSIS DATA PACKAGE

Lab Name: Beacon Environmental Services, Inc. **Contract:** W91237-15-D-0011/CY02

Lab Code: BEACON **Case No.:** **SAS No.:** 1131 **SDG No.:** 3759.17.08.25

Method Type: 8260C

Lab Sample ID	Client Sample ID	QC Description
3759 SG044DUP	SG044-Dup	Field Sample Duplicate
3759 SG045	SG045	
3759 SG046	SG046	
LCS170829C	LCS170829c	Continuing Calibration/Laboratory Control Sample
LB170829C	LB170829c	Method Blank
LCSD170829C	LCSD170829c	Laboratory Control Sample Duplicate
3759 SG047	SG047	
3759 SG048	SG048	
3759 SG049	SG049	
3759 SG050	SG050	
3759 SG051	SG051	
3759 SG052	SG052	
3759 SG053	SG053	
3759 SG054	SG054	
3759 SG055	SG055	
3759 SG055DUP	SG055-Dup	Field Sample Duplicate
3759 SG056	SG056	
3759 SG057	SG057	
3759 SG058	SG058	
3759 SG059	SG059	
3759 SG060	SG060	
3759 SG061	SG061	
3759 SG062	SG062	
3759 SG063	SG063	
3759 SG064	SG064	
3759 SG065	SG065	
3759 SG066	SG066	
3759 SG066DUP	SG066-Dup	Field Sample Duplicate

Comments:

Signature: **Name:** Steven Thornley

Date: **Title:** Laboratory Director

COVER PAGE - VOLATILE ANALYSIS DATA PACKAGE

Lab Name: Beacon Environmental Services, Inc. **Contract:** W91237-15-D-0011/CY02

Lab Code: BEACON **Case No.:** **SAS No.:** 1131 **SDG No.:** 3759.17.08.25

Method Type: 8260C

Lab Sample ID	Client Sample ID	QC Description
3759 SG067	SG067	
3759 SG068	SG068	
3759 SG069	SG069	
3759 SG070	SG070	
3759 SG071	SG071	
3759 SG072	SG072	
3759 SG073	SG073	
3759 SG074	SG074	
3759 SG075	SG075	
3759 SG076	SG076	
3759 SG077	SG077	
3759 SG077DUP	SG077-Dup	Field Sample Duplicate
3759 SG078	SG078	
3759 SG079	SG079	
3759 SG080	SG080	
3759 SG081	SG081	
3759 SG082	SG082	
3759 SG083	SG083	
3759 SG084	SG084	
3759 SG085	SG085	
3759 SG086	SG086	
3759 SG087	SG087	
3759 SG088	SG088	
3759 SG088DUP	SG088-Dup	Field Sample Duplicate
3759 SG089	SG089	
3759 SG090	SG090	
3759 SG091	SG091	
3759 SG092	SG092	

Comments:

Signature: **Name:** Steven Thornley

Date: **Title:** Laboratory Director

COVER PAGE - VOLATILE ANALYSIS DATA PACKAGE

Lab Name: Beacon Environmental Services, Inc. **Contract:** W91237-15-D-0011/CY02

Lab Code: BEACON **Case No.:** **SAS No.:** 1131 **SDG No.:** 3759.17.08.25

Method Type: 8260C

Lab Sample ID	Client Sample ID	QC Description
3759 SG093	SG093	
3759 SG094	SG094	
3759 SG095	SG095	
3759 SG096	SG096	
3759 SG097	SG097	
3759 SG098	SG098	
3759 SG099	SG099	
3759 SG099DUP	SG099-Dup	Field Sample Duplicate
3759 SG100	SG100	
LCS170830C	LCS170830c	Continuing Calibration/Laboratory Control Sample
LB170830C	LB170830c	Method Blank
LCSD170830C	LCSD170830c	Laboratory Control Sample Duplicate
3759 TRIP-4	Trip-4	

Comments:

Signature: **Name:** Steven Thornley

Date: **Title:** Laboratory Director

2C - FORM II VOA-3
VOLATILE DEUTERATED MONITORING COMPOUND RECOVERY

Lab Name: Beacon Environmental Services, I Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref. No.: 1131 SDG No.: 3759.17.08.25

Level: (LOW/MED) LOW

	EPA SAMPLE NO.	VDMC1 (DCA) #	VDMC2 (TOL) #	VDMC3 (BFB) #	VDMC4	VDMC5	VDMC6	VDMC7
01	mb170504c	105	95	97				
02	LCS170828c	98	103	100				
03	LB170828c	99	102	97				
04	LCSD170828c	99	104	99				
05	Trip-1	99	99	104				
06	Trip-2	101	98	103				
07	Trip-3	102	98	104				
08	SG001	101	96	102				
09	SG002	95	94	105				
10	SG003	98	96	104				
11	SG004	97	97	104				
12	SG005	96	96	103				
13	SG006	96	94	104				
14	SG007	94	96	108				
15	SG008	94	96	104				
16	SG009	94	96	102				
17	SG010	90	94	103				
18	SG011	89	96	102				
19	SG011-Dup	94	95	102				
20	SG012	88	97	101				
21	SG013	91	97	103				
22	SG014	92	97	106				
23	SG015	92	95	104				
24	SG016	92	96	103				
25	SG017	94	93	108				
26	SG018	93	90	108				
27	SG019	89	95	103				
28	SG020	78	94	104				
29	SG021	92	93	102				
30	SG022	91	94	103				
31	SG022-Dup	82	96	102				
32	SG023	92	95	103				

	QC LIMITS
VDMC1 (DCA) = 1,2-DCA-d4	(70-130)
VDMC2 (TOL) = Toluene-d8	(70-130)
VDMC3 (BFB) = Bromofluorobenzene	(70-130)

Column to be used to flag recovery values
* Values outside of contract required QC Limits

2C - FORM II VOA-3
VOLATILE DEUTERATED MONITORING COMPOUND RECOVERY

Lab Name: Beacon Environmental Services, I Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref. No.: 1131 SDG No.: 3759.17.08.25

Level: (LOW/MED) LOW

	EPA SAMPLE NO.	VDMC1 (DCA) #	VDMC2 (TOL) #	VDMC3 (BFB) #	VDMC4	VDMC5	VDMC6	VDMC7
33	SG024	93	94	103				
34	SG025	93	93	106				
35	SG026	96	92	106				
36	SG027	90	96	104				
37	SG028	83	96	102				
38	SG029	92	93	106				
39	SG030	77	96	103				
40	SG031	92	94	105				
41	SG032	91	94	106				
42	SG033	90	94	104				
43	SG033-Dup	88	93	102				
44	SG034	90	94	105				
45	SG035	92	93	104				
46	SG035-Dup	73	92	104				
47	SG036	85	96	104				
48	SG037	89	96	104				
49	SG038	88	95	103				
50	SG039	78	94	106				
51	SG040	90	93	105				
52	SG041	89	94	105				
53	SG042	89	93	104				
54	SG043	60 *	95	105				
55	SG044	90	95	106				
56	SG044-Dup	89	92	106				
57	SG045	88	93	105				
58	SG046	82	95	104				

	QC LIMITS
VDMC1 (DCA) = 1,2-DCA-d4	(70-130)
VDMC2 (TOL) = Toluene-d8	(70-130)
VDMC3 (BFB) = Bromofluorobenzene	(70-130)

Column to be used to flag recovery values
* Values outside of contract required QC Limits

2C - FORM II VOA-3
VOLATILE DEUTERATED MONITORING COMPOUND RECOVERY

Lab Name: Beacon Environmental Services, I Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref. No.: 1131 SDG No.: 3759.17.08.25

Level: (LOW/MED) LOW

	EPA SAMPLE NO.	VDMC1 (DCA) #	VDMC2 (TOL) #	VDMC3 (BFB) #	VDMC4	VDMC5	VDMC6	VDMC7
59	LCS170829c	103	102	100				
60	LB170829c	103	102	98				
61	LCSD170829c	101	103	100				
62	SG047	105	98	103				
63	SG048	104	97	101				
64	SG049	104	96	102				
65	SG050	98	98	103				
66	SG051	104	97	101				
67	SG052	102	97	103				
68	SG053	102	96	104				
69	SG054	95	96	102				
70	SG055	100	96	101				
71	SG055-Dup	102	96	103				
72	SG056	103	96	105				
73	SG057	103	96	102				
74	SG058	102	97	103				
75	SG059	97	96	104				
76	SG060	100	93	105				
77	SG061	103	96	104				
78	SG062	103	96	103				
79	SG063	101	94	105				
80	SG064	101	96	102				
81	SG065	100	94	103				
82	SG066	97	95	104				
83	SG066-Dup	99	94	105				
84	SG067	94	98	102				
85	SG068	99	96	103				
86	SG069	96	96	104				
87	SG070	98	95	104				
88	SG071	95	94	104				
89	SG072	96	95	105				
90	SG073	97	96	104				

	QC LIMITS
VDMC1 (DCA) = 1,2-DCA-d4	(70-130)
VDMC2 (TOL) = Toluene-d8	(70-130)
VDMC3 (BFB) = Bromofluorobenzene	(70-130)

Column to be used to flag recovery values
* Values outside of contract required QC Limits

2C - FORM II VOA-3
VOLATILE DEUTERATED MONITORING COMPOUND RECOVERY

Lab Name: Beacon Environmental Services, I Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref. No.: 1131 SDG No.: 3759.17.08.25

Level: (LOW/MED) LOW

	EPA SAMPLE NO.	VDMC1 (DCA) #	VDMC2 (TOL) #	VDMC3 (BFB) #	VDMC4	VDMC5	VDMC6	VDMC7
91	SG074	87	97	102				
92	SG075	96	95	103				
93	SG076	97	94	105				
94	SG077	95	94	104				
95	SG077-Dup	95	95	102				
96	SG078	96	95	106				
97	SG079	90	95	104				
98	SG080	94	95	119				
99	SG081	94	96	106				
	SG082	94	94	106				
	SG083	87	95	103				
	SG084	95	95	103				
	SG085	94	93	104				
	SG086	92	93	105				
	SG087	94	94	105				
	SG088	93	95	106				
	SG088-Dup	84	97	101				
	SG089	93	94	105				
	SG090	92	94	105				
	SG091	95	95	107				
	SG092	82	93	105				
	SG093	91	93	106				
	SG094	91	93	105				
	SG095	91	92	106				
	SG096	89	92	105				
	SG097	78	95	107				
	SG098	83	92	104				
	SG099	91	94	103				
	SG099-Dup	90	91	107				
	SG100	88	93	106				

	QC LIMITS
VDMC1 (DCA) = 1,2-DCA-d4	(70-130)
VDMC2 (TOL) = Toluene-d8	(70-130)
VDMC3 (BFB) = Bromofluorobenzene	(70-130)

Column to be used to flag recovery values
* Values outside of contract required QC Limits

2C - FORM II VOA-3
VOLATILE DEUTERATED MONITORING COMPOUND RECOVERY

Lab Name: Beacon Environmental Services, I Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref. No.: 1131 SDG No.: 3759.17.08.25

Level: (LOW/MED) LOW

EPA SAMPLE NO.	VDMC1 (DCA) #	VDMC2 (TOL) #	VDMC3 (BFB) #	VDMC4	VDMC5	VDMC6	VDMC7
LCS170830c	105	103	101				
LB170830c	104	100	99				
LCSD170830c	103	104	100				
Trip-4	109	97	101				

	QC LIMITS
VDMC1 (DCA) = 1,2-DCA-d4	(70-130)
VDMC2 (TOL) = Toluene-d8	(70-130)
VDMC3 (BFB) = Bromofluorobenzene	(70-130)

Column to be used to flag recovery values
* Values outside of contract required QC Limits

VOLATILE ORGANICS ANALYSIS DATA SHEET
SECOND SOURCE CALIBRATION VERIFICATION

EPA SAMPLE NO.

calv170504c

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

CAS NO.	COMPOUND	SPIKE ng	CALV ng	%D	%D LIMIT	Q
75-01-4	Vinyl chloride	50.0	51	1	(0-30)	
156-60-5	trans-1,2-Dichloroethene	50.0	49	3	(0-30)	
156-59-2	cis-1,2-Dichloroethene	50.0	50	0	(0-30)	
71-43-2	Benzene	50.0	51	2	(0-30)	
79-01-6	Trichloroethene	50.0	50	1	(0-30)	
108-88-3	Toluene	50.0	50	1	(0-30)	
100-41-4	Ethylbenzene	50.0	51	3	(0-30)	
108-38-3	p_m-Xylene	50.0	52	3	(0-30)	
95-47-6	o-Xylene	50.0	51	3	(0-30)	

3C - FORM III VOA-1
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG011-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG011-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082825.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/28/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG022-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG022-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082837.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	9	13	58	(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-1
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG033-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG033-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082849.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG035-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG035-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082852.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-1
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG044-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG044-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082862.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG055-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG055-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082915.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-1
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG066-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG066-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082927.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/29/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG077-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG077-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082939.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/30/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-1
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG088-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG088-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082951.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/30/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3C - FORM III VOA-2
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

3759 SG099-Dup

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix: PSG Lab Sample ID: 3759 SG099-DUP

Sample wt/vol: (g/mL) Lab File ID: C17082963.D

Level (TRACE/LOW/MED): Date Received:

% Moisture: not dec. Date Analyzed: 08/30/2017

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

Dilution Factor: 1.0 CONCENTRATION UNITS: ng

CAS NO.	COMPOUND	FIELD DUP	INITIAL SAMPLE	RPD	RPD LIMIT	Q
75-01-4	Vinyl chloride	5 U	5		(0-100)	
156-60-5	trans-1,2-Dichloroethene	5 U	5		(0-100)	
156-59-2	cis-1,2-Dichloroethene	5 U	5		(0-100)	
71-43-2	Benzene	25.0 U	25.0		(0-100)	
79-01-6	Trichloroethene	5 U	5		(0-100)	
108-88-3	Toluene	25.0 U	25.0		(0-100)	
100-41-4	Ethylbenzene	25.0 U	25.0		(0-100)	
108-38-3	p_m-Xylene	25.0 U	25.0		(0-100)	
95-47-6	o-Xylene	25.0 U	25.0		(0-100)	

3B - FORM III VOA-2

VOLATILE LABORATORY CONTROL SAMPLE RECOVERY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix Spike - EPA Sample No: LCS170828c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	50	100	(80-120)
trans-1,2-Dichloroethe	50.0	54	108	(80-120)
cis-1,2-Dichloroethene	50.0	50	100	(80-120)
Benzene	50.0	50	100	(80-120)
Trichloroethene	50.0	48	96	(80-120)
Toluene	50.0	52	104	(80-120)
Ethylbenzene	50.0	51	102	(80-120)
p & m-Xylene	50.0	50	100	(80-120)
o-Xylene	50.0	50	100	(80-120)

Matrix Spike - EPA Sample No: LCS170829c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	50	100	(80-120)
trans-1,2-Dichloroethe	50.0	52	104	(80-120)
cis-1,2-Dichloroethene	50.0	51	102	(80-120)
Benzene	50.0	51	102	(80-120)
Trichloroethene	50.0	48	96	(80-120)
Toluene	50.0	51	102	(80-120)
Ethylbenzene	50.0	51	102	(80-120)
p & m-Xylene	50.0	50	100	(80-120)
o-Xylene	50.0	49	98	(80-120)

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 0 outside limits

Spike Recovery: 0 out of 9 outside limits

Comments:

3B - FORM III VOA-2

VOLATILE LABORATORY CONTROL SAMPLE RECOVERY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix Spike - EPA Sample No: LCS170830c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	52	104	(80-120)
trans-1,2-Dichloroethe	50.0	53	106	(80-120)
cis-1,2-Dichloroethene	50.0	51	102	(80-120)
Benzene	50.0	51	102	(80-120)
Trichloroethene	50.0	48	96	(80-120)
Toluene	50.0	52	104	(80-120)
Ethylbenzene	50.0	51	102	(80-120)
p & m-Xylene	50.0	50	100	(80-120)
o-Xylene	50.0	49	98	(80-120)

Matrix Spike - EPA Sample No: LCSD170828c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	48	96	(80-120)
trans-1,2-Dichloroethe	50.0	52	104	(80-120)
cis-1,2-Dichloroethene	50.0	51	102	(80-120)
Benzene	50.0	56	112	(80-120)
Trichloroethene	50.0	49	98	(80-120)
Toluene	50.0	54	108	(80-120)
Ethylbenzene	50.0	51	102	(80-120)
p & m-Xylene	50.0	51	102	(80-120)
o-Xylene	50.0	51	102	(80-120)

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 9 outside limits

Spike Recovery: 0 out of 9 outside limits

Comments:

3B - FORM III VOA-2

VOLATILE LABORATORY CONTROL SAMPLE RECOVERY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix Spike - EPA Sample No: LCSD170829c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	52	104	(80-120)
trans-1,2-Dichloroethe	50.0	53	106	(80-120)
cis-1,2-Dichloroethene	50.0	52	104	(80-120)
Benzene	50.0	56	112	(80-120)
Trichloroethene	50.0	49	98	(80-120)
Toluene	50.0	52	104	(80-120)
Ethylbenzene	50.0	52	104	(80-120)
p & m-Xylene	50.0	51	102	(80-120)
o-Xylene	50.0	51	102	(80-120)

Matrix Spike - EPA Sample No: LCSD170830c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONCENTRATION (ng)	LCS % REC#	QC LIMITS REC
Vinyl Chloride	50.0	48	96	(80-120)
trans-1,2-Dichloroethe	50.0	53	106	(80-120)
cis-1,2-Dichloroethene	50.0	51	102	(80-120)
Benzene	50.0	57	114	(80-120)
Trichloroethene	50.0	47	94	(80-120)
Toluene	50.0	54	108	(80-120)
Ethylbenzene	50.0	51	102	(80-120)
p & m-Xylene	50.0	51	102	(80-120)
o-Xylene	50.0	50	100	(80-120)

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 9 outside limits

Spike Recovery: 0 out of 9 outside limits

Comments:

3B - FORM III VOA-2

VOLATILE LCS/LCSD RECOVERY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix Spike - EPA Sample No: LCSD170828c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONC (ng)	LCSD CONC (ng)	LCSD % REC #	LCSD % RPD #	QC LIMITS RPD	QC LIMITS REC
Vinyl Chloride	50.0	50	48	96	4	30	(80-120)
trans-1,2-Dichloroethe	50.0	54	52	104	3	30	(80-120)
cis-1,2-Dichloroethene	50.0	50	51	102	2	30	(80-120)
Benzene	50.0	50	56	112	10	30	(80-120)
Trichloroethene	50.0	48	49	98	1	30	(80-120)
Toluene	50.0	52	54	108	3	30	(80-120)
Ethylbenzene	50.0	51	51	102	0	30	(80-120)
p & m-Xylene	50.0	50	51	102	3	30	(80-120)
o-Xylene	50.0	50	51	102	2	30	(80-120)

Matrix Spike - EPA Sample No: LCSD170829c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONC (ng)	LCSD CONC (ng)	LCSD % REC #	LCSD % RPD #	QC LIMITS RPD	QC LIMITS REC
Vinyl Chloride	50.0	50	52	104	4	30	(80-120)
trans-1,2-Dichloroethe	50.0	52	53	106	1	30	(80-120)
cis-1,2-Dichloroethene	50.0	51	52	104	2	30	(80-120)
Benzene	50.0	51	56	112	10	30	(80-120)
Trichloroethene	50.0	48	49	98	1	30	(80-120)
Toluene	50.0	51	52	104	3	30	(80-120)
Ethylbenzene	50.0	51	52	104	1	30	(80-120)
p & m-Xylene	50.0	50	51	102	3	30	(80-120)
o-Xylene	50.0	49	51	102	4	30	(80-120)

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 9 outside limits

Spike Recovery: 0 out of 9 outside limits

Comments:

3B - FORM III VOA-2

VOLATILE LCS/LCSD RECOVERY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Matrix Spike - EPA Sample No: LCSD170830c Level: (TRACE or LOW/MED) LOW

COMPOUND	SPIKE ADDED (ng)	LCS CONC (ng)	LCSD CONC (ng)	LCSD % REC #	LCSD % RPD #	QC LIMITS RPD	QC LIMITS REC
Vinyl Chloride	50.0	52	48	96	8	30	(80-120)
trans-1,2-Dichloroethe	50.0	53	53	106	2	30	(80-120)
cis-1,2-Dichloroethene	50.0	51	51	102	1	30	(80-120)
Benzene	50.0	51	57	114	11	30	(80-120)
Trichloroethene	50.0	48	47	94	2	30	(80-120)
Toluene	50.0	52	54	108	4	30	(80-120)
Ethylbenzene	50.0	51	51	102	1	30	(80-120)
p & m-Xylene	50.0	50	51	102	3	30	(80-120)
o-Xylene	50.0	49	50	100	1	30	(80-120)

Column to be used to flag recovery and RPD values with an asterisk
* Values outside of QC limits

RPD: 0 out of 9 outside limits

Spike Recovery: 0 out of 9 outside limits

Comments:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
LB170828c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082803.D
Lab Sample ID: LB170828C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 08/28/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 13:47

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
01	LCSD170828c	LCSD170828C	C17082804.D	14:09
02	Trip-1	3759 TRIP-1	C17082810.D	16:25
03	Trip-2	3759 TRIP-2	C17082811.D	16:47
04	Trip-3	3759 TRIP-3	C17082812.D	17:09
05	SG001	3759 SG001	C17082814.D	17:53
06	SG002	3759 SG002	C17082815.D	18:16
07	SG003	3759 SG003	C17082816.D	18:38
08	SG004	3759 SG004	C17082817.D	19:00
09	SG005	3759 SG005	C17082818.D	19:22
10	SG006	3759 SG006	C17082819.D	19:43
11	SG007	3759 SG007	C17082820.D	20:05
12	SG008	3759 SG008	C17082821.D	20:27
13	SG009	3759 SG009	C17082822.D	20:49
14	SG010	3759 SG010	C17082823.D	21:11
15	SG011	3759 SG011	C17082824.D	21:32
16	SG011-Dup	3759 SG011DUP	C17082825.D	21:55
17	SG012	3759 SG012	C17082826.D	22:17
18	SG013	3759 SG013	C17082827.D	22:38
19	SG014	3759 SG014	C17082828.D	23:00
20	SG015	3759 SG015	C17082829.D	23:22
21	SG016	3759 SG016	C17082830.D	23:44
22	SG017	3759 SG017	C17082831.D	00:06
23	SG018	3759 SG018	C17082832.D	00:27
24	SG019	3759 SG019	C17082833.D	00:49
25	SG020	3759 SG020	C17082834.D	01:11
26	SG021	3759 SG021	C17082835.D	01:34
27	SG022	3759 SG022	C17082836.D	01:56
28	SG022-Dup	3759 SG022DUP	C17082837.D	02:18
29	SG023	3759 SG023	C17082838.D	02:39
30	SG024	3759 SG024	C17082839.D	03:01
31	SG025	3759 SG025	C17082840.D	03:23

COMMENTS:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
LB170828c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082803.D
Lab Sample ID: LB170828C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 08/28/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 13:47

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
32	SG026	3759 SG026	C17082841.D	03:45
33	SG027	3759 SG027	C17082842.D	04:07
34	SG028	3759 SG028	C17082843.D	04:29
35	SG029	3759 SG029	C17082844.D	04:51
36	SG030	3759 SG030	C17082845.D	05:13
37	SG031	3759 SG031	C17082846.D	05:35
38	SG032	3759 SG032	C17082847.D	05:57
39	SG033	3759 SG033	C17082848.D	06:19
40	SG033-Dup	3759 SG033DUP	C17082849.D	06:41
41	SG034	3759 SG034	C17082850.D	07:03
42	SG035	3759 SG035	C17082851.D	07:24
43	SG035-Dup	3759 SG035DUP	C17082852.D	07:46
44	SG036	3759 SG036	C17082853.D	08:08
45	SG037	3759 SG037	C17082854.D	08:30
46	SG038	3759 SG038	C17082855.D	08:53
47	SG039	3759 SG039	C17082856.D	09:14
48	SG040	3759 SG040	C17082857.D	09:36
49	SG041	3759 SG041	C17082858.D	09:58
50	SG042	3759 SG042	C17082859.D	10:20
51	SG043	3759 SG043	C17082860.D	10:43
52	SG044	3759 SG044	C17082861.D	11:04
53	SG044-Dup	3759 SG044DUP	C17082862.D	11:26
54	SG045	3759 SG045	C17082863.D	11:48
55	SG046	3759 SG046	C17082864.D	12:10

COMMENTS:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
LB170829c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082903.D
Lab Sample ID: LB170829C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 08/29/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 13:46

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
56	LCSD170829c	LCSD170829C	C17082904.D	14:08
57	SG047	3759 SG047	C17082906.D	14:52
58	SG048	3759 SG048	C17082907.D	15:14
59	SG049	3759 SG049	C17082908.D	15:36
60	SG050	3759 SG050	C17082909.D	15:58
61	SG051	3759 SG051	C17082910.D	16:20
62	SG052	3759 SG052	C17082911.D	16:42
63	SG053	3759 SG053	C17082912.D	17:03
64	SG054	3759 SG054	C17082913.D	17:25
65	SG055	3759 SG055	C17082914.D	17:47
66	SG055-Dup	3759 SG055DUP	C17082915.D	18:09
67	SG056	3759 SG056	C17082916.D	18:31
68	SG057	3759 SG057	C17082917.D	18:53
69	SG058	3759 SG058	C17082918.D	19:15
70	SG059	3759 SG059	C17082919.D	19:37
71	SG060	3759 SG060	C17082920.D	19:59
72	SG061	3759 SG061	C17082921.D	20:20
73	SG062	3759 SG062	C17082922.D	20:42
74	SG063	3759 SG063	C17082923.D	21:04
75	SG064	3759 SG064	C17082924.D	21:26
76	SG065	3759 SG065	C17082925.D	21:48
77	SG066	3759 SG066	C17082926.D	22:10
78	SG066-Dup	3759 SG066DUP	C17082927.D	22:32
79	SG067	3759 SG067	C17082928.D	22:54
80	SG068	3759 SG068	C17082929.D	23:16
81	SG069	3759 SG069	C17082930.D	23:38
82	SG070	3759 SG070	C17082931.D	23:59
83	SG071	3759 SG071	C17082932.D	00:21
84	SG072	3759 SG072	C17082933.D	00:43
85	SG073	3759 SG073	C17082934.D	01:05
86	SG074	3759 SG074	C17082935.D	01:27

COMMENTS:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
LB170829c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082903.D
Lab Sample ID: LB170829C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 08/29/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 13:46

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
87	SG075	3759 SG075	C17082936.D	01:49
88	SG076	3759 SG076	C17082937.D	02:11
89	SG077	3759 SG077	C17082938.D	02:33
90	SG077-Dup	3759 SG077DUP	C17082939.D	02:55
91	SG078	3759 SG078	C17082940.D	03:16
92	SG079	3759 SG079	C17082941.D	03:38
93	SG080	3759 SG080	C17082942.D	04:00
94	SG081	3759 SG081	C17082943.D	04:22
95	SG082	3759 SG082	C17082944.D	04:44
96	SG083	3759 SG083	C17082945.D	05:06
97	SG084	3759 SG084	C17082946.D	05:28
98	SG085	3759 SG085	C17082947.D	05:50
99	SG086	3759 SG086	C17082948.D	06:12
10	SG087	3759 SG087	C17082949.D	06:34
10	SG088	3759 SG088	C17082950.D	06:55
10	SG088-Dup	3759 SG088DUP	C17082951.D	07:17
10	SG089	3759 SG089	C17082952.D	07:39
10	SG090	3759 SG090	C17082953.D	08:01
10	SG091	3759 SG091	C17082954.D	08:22
10	SG092	3759 SG092	C17082955.D	08:45
10	SG093	3759 SG093	C17082956.D	09:07
10	SG094	3759 SG094	C17082957.D	09:28
10	SG095	3759 SG095	C17082958.D	09:51
11	SG096	3759 SG096	C17082959.D	10:12
11	SG097	3759 SG097	C17082960.D	10:34
11	SG098	3759 SG098	C17082961.D	10:56
11	SG099	3759 SG099	C17082962.D	11:18
11	SG099-Dup	3759 SG099DUP	C17082963.D	11:40
11	SG100	3759 SG100	C17082964.D	12:02

COMMENTS:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
LB170830c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17083003.D
Lab Sample ID: LB170830C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 08/30/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 14:02

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
11	LCSD170830c	LCSD170830C	C17083004.D	14:24
11	Trip-4	3759 TRIP-4	C17083006.D	15:08

COMMENTS:

4A - FORM IV VOA
VOLATILE METHOD BLANK SUMMARY

EPA SAMPLE NO.
mb170504c

Lab Name: Beacon Environmental Services
Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.:
Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17072711.D
Lab Sample ID: MB170504C

Instrument ID: INST C

Matrix: PSG
Date Analyzed: 07/27/2017

Level: (TRACE or LOW/MED) LOW
Time Analyzed: 14:43

GC Column: 624silMS ID: 0.18 (mm)

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	TIME ANALYZED
11	LCS170828c	LCS170828C	C17082802.D	13:25

COMMENTS:

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

bfb170504c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17072701.D BFB Injection Date: 07/27/2017

Instrument ID: INST C BFB Injection Time: 10:48

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	18.6
75	30.0 - 80.0% of mass 95	49.1
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.9
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	90.3
175	5.0 - 9.0% of mass 174	6.5 (7.2) 1
176	95.0 - 101% of mass 174	87.5 (96.9) 1
177	5.0 - 9.0% of mass 176	5.8 (6.7) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	10 ng	10 NG	C17072705.D	07/27/2017	12:16
02	25 ng	25 NG	C17072706.D	07/27/2017	12:37
03	50 ng	50 NG	C17072707.D	07/27/2017	12:59
04	100 ng	100 NG	C17072708.D	07/27/2017	13:21
05	200 ng	200 NG	C17072709.D	07/27/2017	13:43
06	calv170504c	CALV170504C	C17072710.D	07/27/2017	14:05
07	mb170504c	MB170504C	C17072711.D	07/27/2017	14:43

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170828c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082801.D BFB Injection Date: 08/28/2017

Instrument ID: INST C BFB Injection Time: 01:04

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.0
75	30.0 - 80.0% of mass 95	48.7
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.6
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.1
175	5.0 - 9.0% of mass 174	5.9 (7.1) 1
176	95.0 - 101% of mass 174	80.6 (97.0) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	LCS170828c	LCS170828C	C17082802.D	08/28/2017	13:25
02	LB170828c	LB170828C	C17082803.D	08/28/2017	13:47
03	LCSD170828c	LCSD170828C	C17082804.D	08/28/2017	14:09
04	Trip-1	3759 TRIP-1	C17082810.D	08/28/2017	16:25
05	Trip-2	3759 TRIP-2	C17082811.D	08/28/2017	16:47
06	Trip-3	3759 TRIP-3	C17082812.D	08/28/2017	17:09
07	SG001	3759 SG001	C17082814.D	08/28/2017	17:53
08	SG002	3759 SG002	C17082815.D	08/28/2017	18:16
09	SG003	3759 SG003	C17082816.D	08/28/2017	18:38
10	SG004	3759 SG004	C17082817.D	08/28/2017	19:00
11	SG005	3759 SG005	C17082818.D	08/28/2017	19:22
12	SG006	3759 SG006	C17082819.D	08/28/2017	19:43
13	SG007	3759 SG007	C17082820.D	08/28/2017	20:05
14	SG008	3759 SG008	C17082821.D	08/28/2017	20:27
15	SG009	3759 SG009	C17082822.D	08/28/2017	20:49
16	SG010	3759 SG010	C17082823.D	08/28/2017	21:11
17	SG011	3759 SG011	C17082824.D	08/28/2017	21:32
18	SG011-Dup	3759 SG011DUP	C17082825.D	08/28/2017	21:55
19	SG012	3759 SG012	C17082826.D	08/28/2017	22:17
20	SG013	3759 SG013	C17082827.D	08/28/2017	22:38
21	SG014	3759 SG014	C17082828.D	08/28/2017	23:00
22	SG015	3759 SG015	C17082829.D	08/28/2017	23:22

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170828c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082801.D BFB Injection Date: 08/28/2017

Instrument ID: INST C BFB Injection Time: 01:04

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.0
75	30.0 - 80.0% of mass 95	48.7
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.6
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.1
175	5.0 - 9.0% of mass 174	5.9 (7.1) 1
176	95.0 - 101% of mass 174	80.6 (97.0) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
23	SG016	3759 SG016	C17082830.D	08/28/2017	23:44
24	SG017	3759 SG017	C17082831.D	08/29/2017	00:06
25	SG018	3759 SG018	C17082832.D	08/29/2017	00:27
26	SG019	3759 SG019	C17082833.D	08/29/2017	00:49
27	SG020	3759 SG020	C17082834.D	08/29/2017	01:11
28	SG021	3759 SG021	C17082835.D	08/29/2017	01:34
29	SG022	3759 SG022	C17082836.D	08/29/2017	01:56
30	SG022-Dup	3759 SG022DUP	C17082837.D	08/29/2017	02:18
31	SG023	3759 SG023	C17082838.D	08/29/2017	02:39
32	SG024	3759 SG024	C17082839.D	08/29/2017	03:01
33	SG025	3759 SG025	C17082840.D	08/29/2017	03:23
34	SG026	3759 SG026	C17082841.D	08/29/2017	03:45
35	SG027	3759 SG027	C17082842.D	08/29/2017	04:07
36	SG028	3759 SG028	C17082843.D	08/29/2017	04:29
37	SG029	3759 SG029	C17082844.D	08/29/2017	04:51
38	SG030	3759 SG030	C17082845.D	08/29/2017	05:13
39	SG031	3759 SG031	C17082846.D	08/29/2017	05:35
40	SG032	3759 SG032	C17082847.D	08/29/2017	05:57
41	SG033	3759 SG033	C17082848.D	08/29/2017	06:19
42	SG033-Dup	3759 SG033DUP	C17082849.D	08/29/2017	06:41
43	SG034	3759 SG034	C17082850.D	08/29/2017	07:03
44	SG035	3759 SG035	C17082851.D	08/29/2017	07:24

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170828c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082801.D BFB Injection Date: 08/28/2017

Instrument ID: INST C BFB Injection Time: 01:04

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.0
75	30.0 - 80.0% of mass 95	48.7
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.6
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.1
175	5.0 - 9.0% of mass 174	5.9 (7.1) 1
176	95.0 - 101% of mass 174	80.6 (97.0) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
45	SG035-Dup	3759 SG035DUP	C17082852.D	08/29/2017	07:46
46	SG036	3759 SG036	C17082853.D	08/29/2017	08:08
47	SG037	3759 SG037	C17082854.D	08/29/2017	08:30
48	SG038	3759 SG038	C17082855.D	08/29/2017	08:53
49	SG039	3759 SG039	C17082856.D	08/29/2017	09:14
50	SG040	3759 SG040	C17082857.D	08/29/2017	09:36
51	SG041	3759 SG041	C17082858.D	08/29/2017	09:58
52	SG042	3759 SG042	C17082859.D	08/29/2017	10:20
53	SG043	3759 SG043	C17082860.D	08/29/2017	10:43
54	SG044	3759 SG044	C17082861.D	08/29/2017	11:04
55	SG044-Dup	3759 SG044DUP	C17082862.D	08/29/2017	11:26
56	SG045	3759 SG045	C17082863.D	08/29/2017	11:48
57	SG046	3759 SG046	C17082864.D	08/29/2017	12:10

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170829c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082901.D BFB Injection Date: 08/29/2017

Instrument ID: INST C BFB Injection Time: 13:02

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.1
75	30.0 - 80.0% of mass 95	48.6
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.8
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.3
175	5.0 - 9.0% of mass 174	5.8 (6.9) 1
176	95.0 - 101% of mass 174	81.7 (98.1) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	LCS170829c	LCS170829C	C17082902.D	08/29/2017	13:24
02	LB170829c	LB170829C	C17082903.D	08/29/2017	13:46
03	LCSD170829c	LCSD170829C	C17082904.D	08/29/2017	14:08
04	SG047	3759 SG047	C17082906.D	08/29/2017	14:52
05	SG048	3759 SG048	C17082907.D	08/29/2017	15:14
06	SG049	3759 SG049	C17082908.D	08/29/2017	15:36
07	SG050	3759 SG050	C17082909.D	08/29/2017	15:58
08	SG051	3759 SG051	C17082910.D	08/29/2017	16:20
09	SG052	3759 SG052	C17082911.D	08/29/2017	16:42
10	SG053	3759 SG053	C17082912.D	08/29/2017	17:03
11	SG054	3759 SG054	C17082913.D	08/29/2017	17:25
12	SG055	3759 SG055	C17082914.D	08/29/2017	17:47
13	SG055-Dup	3759 SG055DUP	C17082915.D	08/29/2017	18:09
14	SG056	3759 SG056	C17082916.D	08/29/2017	18:31
15	SG057	3759 SG057	C17082917.D	08/29/2017	18:53
16	SG058	3759 SG058	C17082918.D	08/29/2017	19:15
17	SG059	3759 SG059	C17082919.D	08/29/2017	19:37
18	SG060	3759 SG060	C17082920.D	08/29/2017	19:59
19	SG061	3759 SG061	C17082921.D	08/29/2017	20:20
20	SG062	3759 SG062	C17082922.D	08/29/2017	20:42
21	SG063	3759 SG063	C17082923.D	08/29/2017	21:04
22	SG064	3759 SG064	C17082924.D	08/29/2017	21:26

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170829c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082901.D BFB Injection Date: 08/29/2017

Instrument ID: INST C BFB Injection Time: 13:02

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.1
75	30.0 - 80.0% of mass 95	48.6
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.8
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.3
175	5.0 - 9.0% of mass 174	5.8 (6.9) 1
176	95.0 - 101% of mass 174	81.7 (98.1) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
23	SG065	3759 SG065	C17082925.D	08/29/2017	21:48
24	SG066	3759 SG066	C17082926.D	08/29/2017	22:10
25	SG066-Dup	3759 SG066DUP	C17082927.D	08/29/2017	22:32
26	SG067	3759 SG067	C17082928.D	08/29/2017	22:54
27	SG068	3759 SG068	C17082929.D	08/29/2017	23:16
28	SG069	3759 SG069	C17082930.D	08/29/2017	23:38
29	SG070	3759 SG070	C17082931.D	08/29/2017	23:59
30	SG071	3759 SG071	C17082932.D	08/30/2017	00:21
31	SG072	3759 SG072	C17082933.D	08/30/2017	00:43
32	SG073	3759 SG073	C17082934.D	08/30/2017	01:05
33	SG074	3759 SG074	C17082935.D	08/30/2017	01:27
34	SG075	3759 SG075	C17082936.D	08/30/2017	01:49
35	SG076	3759 SG076	C17082937.D	08/30/2017	02:11
36	SG077	3759 SG077	C17082938.D	08/30/2017	02:33
37	SG077-Dup	3759 SG077DUP	C17082939.D	08/30/2017	02:55
38	SG078	3759 SG078	C17082940.D	08/30/2017	03:16
39	SG079	3759 SG079	C17082941.D	08/30/2017	03:38
40	SG080	3759 SG080	C17082942.D	08/30/2017	04:00
41	SG081	3759 SG081	C17082943.D	08/30/2017	04:22
42	SG082	3759 SG082	C17082944.D	08/30/2017	04:44
43	SG083	3759 SG083	C17082945.D	08/30/2017	05:06
44	SG084	3759 SG084	C17082946.D	08/30/2017	05:28

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170829c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17082901.D BFB Injection Date: 08/29/2017

Instrument ID: INST C BFB Injection Time: 13:02

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.1
75	30.0 - 80.0% of mass 95	48.6
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.8
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.3
175	5.0 - 9.0% of mass 174	5.8 (6.9) 1
176	95.0 - 101% of mass 174	81.7 (98.1) 1
177	5.0 - 9.0% of mass 176	5.4 (6.6) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
45	SG085	3759 SG085	C17082947.D	08/30/2017	05:50
46	SG086	3759 SG086	C17082948.D	08/30/2017	06:12
47	SG087	3759 SG087	C17082949.D	08/30/2017	06:34
48	SG088	3759 SG088	C17082950.D	08/30/2017	06:55
49	SG088-Dup	3759 SG088DUP	C17082951.D	08/30/2017	07:17
50	SG089	3759 SG089	C17082952.D	08/30/2017	07:39
51	SG090	3759 SG090	C17082953.D	08/30/2017	08:01
52	SG091	3759 SG091	C17082954.D	08/30/2017	08:22
53	SG092	3759 SG092	C17082955.D	08/30/2017	08:45
54	SG093	3759 SG093	C17082956.D	08/30/2017	09:07
55	SG094	3759 SG094	C17082957.D	08/30/2017	09:28
56	SG095	3759 SG095	C17082958.D	08/30/2017	09:51
57	SG096	3759 SG096	C17082959.D	08/30/2017	10:12
58	SG097	3759 SG097	C17082960.D	08/30/2017	10:34
59	SG098	3759 SG098	C17082961.D	08/30/2017	10:56
60	SG099	3759 SG099	C17082962.D	08/30/2017	11:18
61	SG099-Dup	3759 SG099DUP	C17082963.D	08/30/2017	11:40
62	SG100	3759 SG100	C17082964.D	08/30/2017	12:02

5A - FORM V VOA

VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK BROMOFLUOROBENZENE (BFB)

EPA SAMPLE NO.

BFB170830c

Lab Name: Beacon Environmental Services Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: _____ Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Lab File ID: C17083001.D BFB Injection Date: 08/30/2017

Instrument ID: INST C BFB Injection Time: 13:20

GC Column: 624silMS ID: 0.18 (mm) Column Length: 20 (m)

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
50	15.0 - 40.0% of mass 95	19.1
75	30.0 - 80.0% of mass 95	49.0
95	Base Peak, 100% relative abundance	100.0
96	5.0 - 9.0% of mass 95	6.7
173	Less than 2.0% of mass 174	0.5(0.6) 1
174	50.0 - 120% of mass 95	83.1
175	5.0 - 9.0% of mass 174	5.9 (7.1) 1
176	95.0 - 101% of mass 174	80.4 (96.8) 1
177	5.0 - 9.0% of mass 176	5.2 (6.5) 2

1 - Value is %mass 174 2 - Value is %mass 176

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	LCS170830c	LCS170830C	C17083002.D	08/30/2017	13:42
02	LB170830c	LB170830C	C17083003.D	08/30/2017	14:02
03	LCSD170830c	LCSD170830C	C17083004.D	08/30/2017	14:24
04	Trip-4	3759 TRIP-4	C17083006.D	08/30/2017	15:08

6A - FORM VI VOA-1
VOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date(s): 07/27/2017 07/27/2017

Calibration Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

LAB FILE ID: RRF10 = C17072705.D RRF25 = C17072706.D

RRF50 = C17072707.D RRF100 = C17072708.D RRF200 = C17072709.D

COMPOUND	RRF10	RRF25	RRF50	RRF100	RRF200	$\overline{RRF}$	%RSD
Vinyl chloride	0.160	0.207	0.182	0.200	0.195	0.189	9.8
trans-1,2-Dichloroethene	0.417	0.443	0.479	0.416	0.396	0.430	7.4
cis-1,2-Dichloroethene	0.353	0.346	0.355	0.332	0.331	0.343	3.3
Benzene	1.094	1.083	1.064	1.031	1.048	1.064	2.4
Trichloroethene	0.291	0.306	0.302	0.296	0.298	0.299	1.9
Toluene	1.634	1.623	1.665	1.558	1.579	1.612	2.7
Ethylbenzene	1.679	1.688	1.644	1.660	1.679	1.670	1.1
p_m-Xylene	1.321	1.334	1.274	1.289	1.290	1.302	1.9
o-Xylene	0.652	0.653	0.607	0.632	0.650	0.639	3.1

6C - FORM VI VOA-3
VOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date(s): 07/27/2017 07/27/2017

Calibration Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

LAB FILE ID: RRF10 = C17072705. RRF25 = C17072706.D

RRF50 = C17072707.D RRF100 = C17072708.D RRF200 = C17072709.

COMPOUND	RRF10	RRF25	RRF50	RRF100	RRF200	$\overline{RRF}$	% RSD
1,2-DCA-d4	0.322	0.324	0.330	0.323	0.313	0.322	1.9
Toluene-d8	1.374	1.327	1.370	1.317	1.335	1.345	1.9
Bromofluorobenzene	0.530	0.492	0.462	0.465	0.464	0.483	6.1

7A - FORM VII VOA-1
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 07/27/2017 Time: 12:59

Lab File ID: C17072707.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): 50 ng Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	RRF	RRF50	MIN RRF	%D	MAX%D
Vinyl chloride	0.189	0.182	0.100	-3.7	20.0
trans-1,2-Dichloroethene	0.430	0.479	0.100	11.4	20.0
cis-1,2-Dichloroethene	0.343	0.355	0.100	3.5	20.0
Benzene	1.064	1.064	0.500	0.0	20.0
Trichloroethene	0.299	0.302	0.200	1.0	20.0
Toluene	1.612	1.665	0.400	3.3	20.0
Ethylbenzene	1.670	1.644	0.100	-1.6	20.0
p_m-Xylene	1.302	1.274	0.100	-2.2	20.0
o-Xylene	0.639	0.607	0.300	-5.0	20.0

7B - FORM VII VOA-2
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/28/2017 Time: 13:25

Lab File ID: C17082802.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170828c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	RRF	RRF50	MIN RRF	%D	MAX%D
Vinyl chloride	0.189	0.188	0.100	-0.5	20.0
trans-1,2-Dichloroethene	0.430	0.462	0.100	7.4	20.0
cis-1,2-Dichloroethene	0.343	0.345	0.100	0.6	20.0
Benzene	1.064	1.076	0.500	1.1	20.0
Trichloroethene	0.299	0.291	0.200	-2.7	20.0
Toluene	1.612	1.677	0.400	4.0	20.0
Ethylbenzene	1.670	1.713	0.100	2.6	20.0
p_m-Xylene	1.302	1.300	0.100	-0.2	20.0
o-Xylene	0.639	0.641	0.300	0.3	20.0

7A - FORM VII VOA-1
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/29/2017 Time: 13:24

Lab File ID: C17082902.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170829c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	RRF	RRF50	MIN RRF	%D	MAX%D
Vinyl chloride	0.189	0.190	0.100	0.5	20.0
trans-1,2-Dichloroethene	0.430	0.452	0.100	5.1	20.0
cis-1,2-Dichloroethene	0.343	0.351	0.100	2.3	20.0
Benzene	1.064	1.088	0.500	2.3	20.0
Trichloroethene	0.299	0.288	0.200	-3.7	20.0
Toluene	1.612	1.646	0.400	2.1	20.0
Ethylbenzene	1.670	1.698	0.100	1.7	20.0
p_m-Xylene	1.302	1.301	0.100	-0.1	20.0
o-Xylene	0.639	0.624	0.300	-2.3	20.0

7B - FORM VII VOA-2
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/30/2017 Time: 13:42

Lab File ID: C17083002.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170830c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	RRF	RRF50	MIN RRF	%D	MAX%D
Vinyl chloride	0.189	0.198	0.100	4.8	20.0
trans-1,2-Dichloroethene	0.430	0.454	0.100	5.6	20.0
cis-1,2-Dichloroethene	0.343	0.355	0.100	3.5	20.0
Benzene	1.064	1.090	0.500	2.4	20.0
Trichloroethene	0.299	0.289	0.200	-3.3	20.0
Toluene	1.612	1.668	0.400	3.5	20.0
Ethylbenzene	1.670	1.687	0.100	1.0	20.0
p_m-Xylene	1.302	1.299	0.100	-0.2	20.0
o-Xylene	0.639	0.628	0.300	-1.7	20.0

7C - FORM VII VOA-3
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 07/27/2017 Time: 12:59

Lab File ID: C17072707.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): 50 ng Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	- RRF	RRF50	MIN RRF	%D	MAX%D
1,2-DCA-d4	0.322	0.330	0.100	2.5	20.0
Toluene-d8	1.345	1.370	0.100	1.9	20.0
Bromofluorobenzene	0.483	0.462	0.100	-4.3	20.0

7C - FORM VII VOA-3
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/28/2017 Time: 13:25

Lab File ID: C17082802.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170828c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	- RRF	RRF50	MIN RRF	%D	MAX%D
1,2-DCA-d4	0.322	0.318	0.100	-1.2	20.0
Toluene-d8	1.345	1.388	0.100	3.2	20.0
Bromofluorobenzene	0.483	0.482	0.100	-0.2	20.0

7C - FORM VII VOA-3
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/29/2017 Time: 13:24

Lab File ID: C17082902.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170829c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	- RRF	RRF50	MIN RRF	%D	MAX%D
1,2-DCA-d4	0.322	0.333	0.100	3.4	20.0
Toluene-d8	1.345	1.365	0.100	1.5	20.0
Bromofluorobenzene	0.483	0.482	0.100	-0.2	20.0

7C - FORM VII VOA-3
VOLATILE CONTINUING CALIBRATION DATA

Lab Name: Beacon Environmental Services, Inc Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

Instrument ID: INST C Calibration Date: 08/30/2017 Time: 13:42

Lab File ID: C17083002.D Init. Calib. Date(s): 07/27/2017 07/27/2017

EPA Sample No. (VSTD#####): LCS170830c Init. Calib. Time(s): 12:16 13:43

GC Column: 624silMS ID: 0.18 (mm) Length: 20 (m)

COMPOUND	- RRF	RRF50	MIN RRF	%D	MAX%D
1,2-DCA-d4	0.322	0.339	0.100	5.3	20.0
Toluene-d8	1.345	1.391	0.100	3.4	20.0
Bromofluorobenzene	0.483	0.485	0.100	0.4	20.0

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): 50 ng Date Analyzed: 07/27/2017

Lab File ID (Standard): C17072707.D Time Analyzed: 12:59

Instrument ID: INST C

	IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
EPA SAMPLE NO.						
01 calv170504c	138950	5.24	85726	8.86	44099	10.61
02 mb170504c	130157	5.24	87911	8.86	42766	10.61

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170828c Date Analyzed: 08/28/2017

Lab File ID (Standard): C17082802.D Time Analyzed: 13:25

Instrument ID: INST C

		IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
	12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
	UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
	LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
	EPA SAMPLE NO.						
01	LCS170828c	145035	5.24	87195	8.86	42054	10.60
02	LB170828c	151439	5.24	88691	8.86	39714	10.61
03	LCSD170828c	175565	5.24	102954	8.86	50458	10.60
04	Trip-1	166344	5.24	100969	8.86	52332	10.60
05	Trip-2	157576	5.24	100529	8.86	50839	10.60
06	Trip-3	159270	5.24	101711	8.86	51476	10.60
07	SG001	157799	5.24	103465	8.86	52486	10.60
08	SG002	120715	5.23	87521	8.86	46990	10.60
09	SG003	141274	5.24	94866	8.86	50578	10.60
10	SG004	146442	5.24	95535	8.86	49856	10.60
11	SG005	151716	5.24	101925	8.86	53354	10.60
12	SG006	147216	5.24	100809	8.86	52941	10.60
13	SG007	156828	5.24	104702	8.86	57746	10.60
14	SG008	151497	5.24	102589	8.86	54492	10.60
15	SG009	154117	5.24	102852	8.86	53639	10.60
16	SG010	149435	5.24	105793	8.86	53967	10.60
17	SG011	147916	5.24	102133	8.86	52345	10.61
18	SG011-Dup	152405	5.24	105445	8.86	54296	10.60
19	SG012	146958	5.24	100317	8.86	51316	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170828c Date Analyzed: 08/28/2017

Lab File ID (Standard): C17082802.D Time Analyzed: 13:25

Instrument ID: INST C

	IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
EPA SAMPLE NO.						
20 SG013	151728	5.24	103485	8.86	53431	10.60
21 SG014	148865	5.24	101833	8.86	53997	10.60
22 SG015	142210	5.24	100451	8.86	53135	10.60
23 SG016	150242	5.24	102884	8.86	53304	10.60
24 SG017	133678	5.24	99592	8.86	53784	10.60
25 SG018	118580	5.24	92933	8.86	50806	10.60
26 SG019	141987	5.24	99753	8.86	51792	10.60
27 SG020	136986	5.24	97298	8.86	51076	10.60
28 SG021	128519	5.24	95479	8.86	49233	10.60
29 SG022	149403	5.24	104005	8.86	53850	10.60
30 SG022-Dup	153047	5.24	105540	8.86	53577	10.60
31 SG023	144413	5.24	100392	8.86	51106	10.60
32 SG024	140862	5.24	99746	8.86	51529	10.60
33 SG025	135749	5.24	96487	8.86	51335	10.60
34 SG026	136129	5.24	100750	8.86	53633	10.60
35 SG027	153685	5.24	105340	8.86	54392	10.60
36 SG028	151661	5.24	104281	8.86	53609	10.61
37 SG029	134933	5.23	99126	8.86	53268	10.60
38 SG030	145010	5.24	100226	8.86	51170	10.61

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170828c Date Analyzed: 08/28/2017

Lab File ID (Standard): C17082802.D Time Analyzed: 13:25

Instrument ID: INST C

		IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
	12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
	UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
	LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
	EPA SAMPLE NO.						
39	SG031	137461	5.24	100028	8.86	52839	10.60
40	SG032	134471	5.23	98743	8.86	52028	10.60
41	SG033	138706	5.24	101744	8.86	52541	10.61
42	SG033-Dup	139424	5.24	100664	8.86	52680	10.60
43	SG034	132562	5.24	96533	8.86	51776	10.60
44	SG035	133996	5.24	101233	8.86	52500	10.60
45	SG035-Dup	136566	5.24	101615	8.86	53027	10.60
46	SG036	139477	5.24	99707	8.86	52691	10.60
47	SG037	140381	5.24	102442	8.86	53004	10.61
48	SG038	131470	5.24	99235	8.86	52256	10.60
49	SG039	132052	5.24	100136	8.86	53067	10.60
50	SG040	125270	5.24	94689	8.86	49894	10.60
51	SG041	131838	5.24	95692	8.86	50669	10.60
52	SG042	127881	5.24	94542	8.86	50598	10.60
53	SG043	138930	5.24	100712	8.86	52198	10.60
54	SG044	136269	5.24	98741	8.86	52246	10.60
55	SG044-Dup	121414	5.24	96898	8.86	52781	10.60
56	SG045	126845	5.24	99555	8.86	52080	10.61
57	SG046	126476	5.24	93969	8.86	49089	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170829c Date Analyzed: 08/29/2017

Lab File ID (Standard): C17082902.D Time Analyzed: 13:24

Instrument ID: INST C

		IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
	12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
	UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
	LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
	EPA SAMPLE NO.						
01	LCS170829c	182175	5.24	109714	8.86	51834	10.60
02	LB170829c	181039	5.24	107668	8.86	47967	10.60
03	LCSD170829c	176732	5.24	106113	8.86	52155	10.60
04	SG047	149640	5.24	94445	8.86	48780	10.60
05	SG048	160353	5.24	102593	8.86	51681	10.60
06	SG049	145384	5.24	98339	8.86	49370	10.60
07	SG050	160884	5.24	101859	8.86	51885	10.60
08	SG051	151819	5.24	98566	8.86	49040	10.60
09	SG052	149624	5.24	96149	8.86	49622	10.60
10	SG053	153695	5.24	100409	8.86	51414	10.61
11	SG054	148288	5.24	98794	8.86	50347	10.60
12	SG055	151253	5.24	101532	8.86	51323	10.60
13	SG055-Dup	141364	5.24	93256	8.86	47915	10.61
14	SG056	146384	5.24	97933	8.86	50791	10.60
15	SG057	150379	5.24	99274	8.86	50534	10.60
16	SG058	154170	5.24	100972	8.86	51962	10.60
17	SG059	149011	5.24	99196	8.86	50903	10.61
18	SG060	128566	5.24	90097	8.86	47353	10.61
19	SG061	155969	5.24	100948	8.86	52664	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170829c Date Analyzed: 08/29/2017

Lab File ID (Standard): C17082902.D Time Analyzed: 13:24

Instrument ID: INST C

	IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
EPA SAMPLE NO.						
20 SG062	149027	5.24	98537	8.86	50964	10.60
21 SG063	146371	5.24	99074	8.86	52419	10.61
22 SG064	148661	5.24	97932	8.86	50546	10.61
23 SG065	136255	5.24	96378	8.86	50356	10.61
24 SG066	144720	5.24	101729	8.86	52695	10.60
25 SG066-Dup	145734	5.24	101098	8.86	53170	10.61
26 SG067	158124	5.24	102729	8.86	52370	10.60
27 SG068	145280	5.24	100781	8.86	52254	10.61
28 SG069	144595	5.24	98287	8.86	50305	10.60
29 SG070	143697	5.23	99502	8.86	52197	10.61
30 SG071	138182	5.24	98371	8.86	50649	10.60
31 SG072	143697	5.24	99223	8.86	51609	10.60
32 SG073	141179	5.24	97118	8.86	50294	10.60
33 SG074	137971	5.24	96404	8.86	49523	10.60
34 SG075	141899	5.24	98561	8.86	50747	10.60
35 SG076	137014	5.24	96959	8.86	50365	10.60
36 SG077	136831	5.24	97461	8.86	49655	10.61
37 SG077-Dup	129956	5.24	93402	8.86	47924	10.60
38 SG078	136390	5.24	97597	8.86	50784	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170829c Date Analyzed: 08/29/2017

Lab File ID (Standard): C17082902.D Time Analyzed: 13:24

Instrument ID: INST C

		IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
	12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
	UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
	LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
	EPA SAMPLE NO.						
39	SG079	137248	5.24	95524	8.86	48993	10.60
40	SG080	136874	5.24	97462	8.86	57581	10.60
41	SG081	140187	5.24	99554	8.86	52243	10.61
42	SG082	134739	5.24	96287	8.86	51196	10.61
43	SG083	139538	5.24	97876	8.86	49837	10.60
44	SG084	137002	5.24	97894	8.86	51388	10.61
45	SG085	130039	5.24	96893	8.86	50686	10.60
46	SG086	126721	5.23	93008	8.86	48785	10.60
47	SG087	125898	5.24	93566	8.86	49446	10.60
48	SG088	134250	5.24	97513	8.86	51657	10.60
49	SG088-Dup	148165	5.24	101082	8.86	52162	10.61
50	SG089	135515	5.24	96799	8.86	50227	10.60
51	SG090	136295	5.24	97247	8.86	51260	10.60
52	SG091	134834	5.24	97061	8.86	51145	10.60
53	SG092	129053	5.24	95515	8.86	50415	10.60
54	SG093	127464	5.24	96175	8.86	51102	10.60
55	SG094	131593	5.24	99474	8.86	52757	10.60
56	SG095	129505	5.24	96877	8.86	52007	10.61
57	SG096	126546	5.23	96770	8.86	51025	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170829c Date Analyzed: 08/29/2017

Lab File ID (Standard): C17082902.D Time Analyzed: 13:24

Instrument ID: INST C

		IS1 (FLB) AREA #	RT #	IS2 (CBZ) AREA #	RT #	IS3 (DCB) AREA #	RT #
	12 HOUR STD	154077	5.25	90274	8.86	42801	10.61
	UPPER LIMIT	462231	5.42	270822	9.03	128403	10.78
	LOWER LIMIT	77039	5.08	45137	8.69	21401	10.44
	EPA SAMPLE NO.						
58	SG097	136348	5.24	99126	8.86	52788	10.60
59	SG098	127549	5.24	96043	8.86	50770	10.61
60	SG099	130957	5.24	94646	8.86	49391	10.60
61	SG099-Dup	117714	5.24	91103	8.86	48731	10.60
62	SG100	124421	5.23	93123	8.86	50825	10.60

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

8A - FORM VIII VOA
VOLATILE INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

Lab Name: Beacon Environmental Services, Inc. Contract: W91237-15-D-0011/CY02

Lab Code: BEACON Case No.: Mod. Ref No.: 1131 SDG No.: 3759.17.08.25

GC Column: 624silMS ID: 0.18 (mm) Init. Calib. Date(s): 7/27/2017 7/27/2017

EPA Sample No. (VSTD#####): LCS170830c Date Analyzed: 08/30/2017

Lab File ID (Standard): C17083002.D Time Analyzed: 13:42

Instrument ID: INST C

		IS1 (FLB) AREA	#	RT	#	IS2 (CBZ) AREA	#	RT	#	IS3 (DCB) AREA	#	RT	#
	12 HOUR STD	154077		5.25		90274		8.86		42801		10.61	
	UPPER LIMIT	462231		5.42		270822		9.03		128403		10.78	
	LOWER LIMIT	77039		5.08		45137		8.69		21401		10.44	
	EPA SAMPLE NO.												
01	LCS170830c	178994		5.24		105894		8.86		50025		10.60	
02	LB170830c	169660		5.24		103408		8.86		46183		10.60	
03	LCSD170830c	179610		5.24		105440		8.86		51965		10.61	
04	Trip-4	151701		5.24		95633		8.86		48649		10.61	

IS1 (FLB) = Fluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,4-Dichlorobenzene-d4

AREA UPPER LIMIT = +200% of internal standard area
AREA LOWER LIMIT = -50% of internal standard area
RT UPPER LIMIT = +0.17 minutes of internal standard RT
RT LOWER LIMIT = -0.17 minutes of internal standard RT

Column used to flag values outside QC limits with an asterisk.

ATTACHMENT 4: LABORATORY RESULTS

Table 1. Analytical results of target VOCs in monitoring well samples

Analyte	TCE		cis-1,2-DCE		trans-1,2-DCE		VC	
CAS#	79-01-6		156-59-2		156-60-5		75-01-4	
USEPA MCL	5		70		100		2	
Sample ID	Result LQ (µg/L)	VQ	Result LQ (µg/L)	VQ	Result LQ (µg/L)	VQ	Result LQ (µg/L)	VQ
MW-08-081217	**6.4**		0.05 U	U	0.05 U	U	0.05 U	U
MW-19-081217	**19**		0.05 U	U	0.05 U	U	0.05 U	U
MW-23-081217	**34**		0.25 U	U	0.25 U	U	0.25 U	U
MW-24-081217	**8.1**		0.05 U	U	0.05 U	U	0.05 U	U
MW-25-081317	**2.8**		0.05 U	U	0.05 U	U	0.05 U	U
MW-26-081217	**19**		0.05 U	U	0.05 U	U	0.05 U	U
MW-27-081217	**9.2**		0.05 U	U	0.05 U	U	0.05 U	U
MW-30-081317	**1.2**		0.05 U	U	0.05 U	U	0.05 U	U
MW-31-081217	**25**		**0.92**		**0.21**		0.05 U	U
MW-32-081217	**9.4**		0.05 U	U	0.05 U	U	0.05 U	U
MW-33-081217	**42**		0.25 U	U	0.25 U	U	**0.11 J**	**J**
DUP-081217-01[1]	**40**		0.25 U	U	0.25 U	U	0.25 U	U
MW-34A-081317	0.05 U	U	0.05 U	U	0.05 U	U	0.05 U	U
MW-34B-081317	**29**		0.25 U	U	0.25 U	U	0.25 U	U
MW-34C-081317	**5.8**		**0.061 J**	**J**	0.05 U	U	0.05 U	U
MW-36-081317	**8.7**		0.05 U	U	0.05 U	U	0.05 U	U
MW-37-081317	**5.1**		0.05 U	U	0.05 U	U	0.05 U	U
DUP-081317-01[1]	**7.1**		0.05 U	U	0.05 U	U	0.05 U	U

[1] DUP-081217-01 is the duplicate sample for MW-33-081217; DUP-081317-01 is the duplicate sample for MW-37-081317

CAS: Chemical Abstract Service; ID: identification; J: estimated value; LQ: laboratory qualifier; MCL: Maximum Contaminant Level; U: not-detected; USEPA: U.S. Environmental Protection Agency; VQ: validation qualifier; µg/L: micrograms per liter; cis-1,2-DCE: cis-1,2-dichloroethene; trans-1,2-DCE: trans-1,2-dichloroethene; TCE: trichloroethene; VC: vinyl chloride

Table 2. Analytical results of target VOCs in soil and liquid samples from Vaults 3 and 4

Analyte	TCE	cis-1,2-DCE	trans-1,2-DCE	VC	
Units	(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	Notes
CAS#	79-01-6	156-59-2	156-60-5	75-01-4	
USEPA Residential Soil RSL [1]	410	16000	160000	59	
MDEQ Groundwater Protection Criterion	100	1400	2000	40	
Soil Samples					
Vault 3	1.0 U	1.0 U	1.0 U	1.0 U	Collected ~6 feet from the ground surface.
Vault 4-001	0.92 U	340	50.2	10.4	Collected from center chamber ~8 feet bgs.
Vault 4-002	1.1 U	158	17.0	4.56	Collected from center chamber ~8 feet bgs.
Vault 4-003	1.2 U	394	69.6	24.3	Collected from center chamber ~8 feet bgs.
Vault 4-North	1.2 U	512	32.1	6.72	Collected from northern chamber ~8 feet bgs.
Vault 4-South	24 U	24 U	24 U	24 U	Collected from southern chamber ~8feet bgs.

Analyte	TCE	cis-1,2-DCE	trans-1,2-DCE		
Units	(µg/L)	(µg/L)	(µg/L)	VC (µg/L)	
CAS#	79-01-6	156-59-2	156-60-5	75-01-4	
USEPA MCL [1]	5	70	100	2	
Liquid Samples					
Vault 4-3	0.032 J	57.0	7.8	4.0	Collected from northern chamber ~8 feet bgs.

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

CAS: Chemical Abstract Service, J: estimated value; MCL: Maximum Contaminant Level; MDEQ: Michigan Department of Environmental Quality; RSL: Regional Screening Level;

U: not detected; USEPA: U.S. Environmental Protection Agency; µg/kg: micrograms per kilogram; µg/L: micrograms per liter

cis-1,2-DCE: cis-1,2-dichloroethene; trans-1,2-DCE: trans-1,2-dichloroethene, TCE: trichloroethene, VC: vinyl chloride

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

		Analyte TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
USEPA Residential Soil RSL [1]		0.41	16	0.059
MDEQ Groundwater Protection Criterion		0.1	1.4	0.04
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-35-17.5	9/18/2017	0.009 U	0.009 U	0.009 U
VSB-35-20	9/18/2017	0.009 U	0.009 U	0.009 U
VSB-35-22.5	9/18/2017	0.010 U	0.010 U	0.010 U
VSB-35-25	9/18/2017	0.009 U/ 0.009 U	0.009 U/ 0.009 U	0.009 U/ 0.009 U
VSB-38-2.5	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-38-5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-38-7.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-38-10	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-38-12.5	9/23/2017	0.011 U	0.011 U	0.011 U
VSB-38-15	9/24/2017	0.011 U	0.011 U	0.011 U
VSB-38-17.5	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-38-20	9/24/2017	0.011 U	0.011 U	0.011 U
VSB-38-22.5	9/24/2017	0.009 U	0.009 U	0.009 U
VSB-38-25	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-38-27.5	9/24/2017	0.008 U	0.008 U	0.008 U
VSB-39-5	9/21/2017	0.008 U	0.008 U	0.008 U
VSB-39-10	9/21/2017	0.008 U / 0.007 U	**0.435 / 0.655**	0.008 U / 0.007 U
VSB-39-12.5	9/21/2017	0.074 U	**3.050**	0.074 U
VSB-39-13	9/21/2017	0.162 U	**13.683**	0.162 U
VSB-39-14	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-39-16	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-2.5	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-5	9/22/2017	0.004 U	0.004 U	0.004 U
VSB-41-7.5	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-8-13	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-14	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-15	9/22/2017	0.009 U / 0.008 U	0.009 U / 0.008 U	0.009 U / 0.008 U
VSB-41-16	9/22/2017	0.009 U	0.009 U	0.009 U
VSB-41-18	9/22/2017	0.011 U	0.011 U	0.011 U
VSB-41-20	9/22/2017	0.010 U	0.010 U	0.010 U
VSB-41-22	9/22/2017	0.008 U	0.008 U	0.008 U
VSB-41-24.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-41-27	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-41-29.5	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-41-32	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-41-34.5	9/23/2017	0.009 U	0.009 U	0.009 U
VSB-41-37	9/23/2017	0.012 U / 0.008 U	0.012 U / 0.008 U	0.012 U / 0.008 U
VSB-41-39.5	9/23/2017	0.010 U	0.010 U	0.010 U
VSB-41-42	9/23/2017	0.008 U	0.008 U	0.008 U
VSB-42-13	9/24/2017	**50.001**	**55.884**	0.452 U

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

		Analyte TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
USEPA Residential Soil RSL [1]		0.41	16	0.059
MDEQ Groundwater Protection Criterion		0.1	1.4	0.04
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-46-2.5	9/28/2017	0.014 U	0.014 U	0.014 U
VSB-46-5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-46-10	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-12.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-15	9/28/2017	0.007 U	0.007 U	0.007 U
VSB-46-17.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-20	9/28/2017	0.011 U	0.011 U	0.011 U
VSB-46-22.5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-46-25	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-27.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-30	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-32.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-35	9/28/2017	0.011 U	0.011 U	0.011 U
VSB-46-37.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-40	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-46-42.5	9/28/2017	0.019 U	0.019 U	0.019 U
VSB-46-45	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-46-49	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-46-50	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-2.5	9/28/2017	0.014 U	0.014 U	0.014 U
VSB-47-5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-7.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-10	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-12.5	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-15	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-47-17.5	9/28/2017	0.010 U	0.010 U	0.010 U
VSB-47-20	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-22.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-25	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-27.5	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-47-30	9/28/2017	0.008 U	0.008 U	0.008 U
VSB-47-32.5	9/28/2017	0.009 U	0.009 U	0.009 U
VSB-47-35	9/28/2017	0.012 U	0.012 U	0.012 U
VSB-47-37.5	9/28/2017	0.015 U	0.015 U	0.015 U
VSB-47-40	9/28/2017	0.014 U	0.014 U	0.014 U
VSB-47-42.5	9/28/2017	0.013 U	0.013 U	0.013 U
VSB-47-45	9/28/2017	0.011 U	0.011 U	0.011 U

Table 3. Analytical results of target VOCs in 2017 soil samples analyzed by the on-site mobile laboratory

		Analyte	TCE (mg/kg)	DCE (mg/kg) [2]	VC+1,2 DCA (mg/kg) [3]
		USEPA Residential Soil RSL [1]	0.41	16	0.059
		MDEQ Groundwater Protection Criterion	0.1	1.4	0.04
Sample Name	Date Sampled		On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-48-2.5	9/29/2017		0.011 U	0.011 U	0.011 U
VSB-48-5	9/29/2017		0.019 U	0.019 U	0.019 U
VSB-48-7.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-48-10	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-48-12.5	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-15	9/29/2017		0.012 U	0.012 U	0.012 U
VSB-48-17.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-48-20	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-22.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-48-25	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-27.5	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-30	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-32.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-48-35	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-37.5	9/29/2017		0.011 U	0.011 U	0.011 U
VSB-48-40	9/29/2017		0.013 U	0.013 U	0.013 U
VSB-48-42.5	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-48-45	9/29/2017		0.008 U	0.008 U	0.008 U
VSB-49-2.5	9/29/2017		0.011 U	0.011 U	0.011 U
VSB-49-5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-7.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-10	9/29/2017		0.012 U	0.012 U	0.012 U
VSB-49-12.5	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-49-15	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-17.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-20	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-22.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-25	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-27.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-30	9/29/2017		0.011 U	0.011 U	0.011 U
VSB-49-32.5	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-35	9/29/2017		0.010 U	0.010 U	0.010 U
VSB-49-37.5	9/29/2017		0.009 U	0.009 U	0.009 U
VSB-49-40	9/29/2017		0.008 U	0.008 U	0.008 U
VSB-49-42.5	9/29/2017		0.007 U	0.007 U	0.007 U
VSB-49-45	9/29/2017		0.009 U	0.009 U	0.009 U

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

[2] screening levels for cis-1,2-DCE shown here. It is the lower of the cis and trans isomer RSLs.

[3] screening levels for VC shown here.

MDEQ: Michigan Department of Environmental Quality; mg/kg: milligram per kilogram; RSL: Regional Screening Level;

U: not detected; USEPA: U.S. Environmental Protection Agency;

DCA: dichloroethane; DCE: dichloroethene (sum of cis-1,2-DCE and trans-1,2-DCE); TCE: trichloroethene; VC: vinyl chloride

Table 4. Analytical results of target VOCs in 2017 groundwater samples analyzed by the on-site mobile laboratory

	Analyte	TCE (µg/L)	DCE (µg/L) [2]	VC+1,2 DCA (µg/L) [3]
	USEPA MCL [1]	5	70	2
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
VSB-35-53.4	9/19/2017	2 U	2 U	2 U
VSB-35-63.3	9/19/2017	2 U	2 U	2 U
VSB-35-68	9/19/2017	2 U	2 U	2 U
VSB-35-78A	9/19/2017	2 U	2 U	2 U
VSB-35-78B	9/19/2017	2 U	2 U	2 U
VSB-35-83	9/19/2017	2 U	2 U	2 U
VSB-36-51	9/18/2017	2 U	2 U	2 U
VSB-36-61	9/19/2017	2 U	2 U	2 U
VSB-36-66	9/19/2017	2 U	2 U	2 U
VSB-36-76	9/19/2017	2 U	2 U	2 U
VSB-36-80	9/19/2017	2 U	2 U	2 U
VSB-37-46	9/21/2017	2 U	2 U	2 U
VSB-37-56	9/21/2017	2 U	2 U	2 U
VSB-37-66	9/21/2017	**22.1**	2 U	2 U
VSB-37-76	9/22/2017	**19.2**	2 U	2 U
VSB-37-78	9/22/2017	**15.4/15.2**	2 U/2U	2 U/2U
VSB-38-50	9/21/2017	2 U	2 U	2 U
VSB-38-60	9/21/2017	**26.2**	2 U	2 U
VSB-38-70	9/21/2017	2 U	2 U	2 U
VSB-38-77	9/21/2017	2 U	2 U	2 U
VSB-38-80	9/21/2017	2 U	2 U	2 U
VSB-40-50*	9/22/2017	**12.1**	2 U	2 U
VSB-40-61*	9/22/2017	2 U	2 U	2 U
VSB-40-70*	9/22/2017	2 U	2 U	2 U
VSB-40-50A	9/23/2017	**6.4/8.8**	2 U/2U	2 U/2U
VSB-40-60A	9/23/2017	**10.2**	2 U	2 U
VSB-40-70A	9/23/2017	2 U	2 U	2 U
VSB-40-77A	9/23/2017	2 U	2 U	2 U
VSB-41-51	9/23/2017	**32.7**	2 U	2 U
VSB-41-61	9/23/2017	2 U	2 U	2 U
VSB-41-66	9/24/2017	2 U	2 U	2 U
VSB-41A-52	9/27/2017	**8.2**	2 U	2 U
VSB-41A-60	9/27/2017	2 U	2 U	2 U
VSB-43-49	9/24/2017	2 U	2 U	2 U
VSB-43-54	9/24/2017	2 U	2 U	2 U
VSB-44-46	9/24/2017	2 U	2 U	2 U
VSB-44-51	9/24/2017	2 U	2 U	2 U
VSB-44-56	9/24/2017	2 U	2 U	2 U
VSB-45-46	9/24/2017	2 U	2 U	2 U
VSB-45-51	9/24/2017	2 U	2 U	2 U
VSB-45-56	9/24/2017	2 U	2 U	2 U

Table 4. Analytical results of target VOCs in 2017 groundwater samples analyzed by the on-site mobile laboratory

	Analyte	TCE (µg/L)	DCE (µg/L) [2]	VC+1,2 DCA (µg/L) [3]
	USEPA MCL [1]	5	70	2
Sample Name	Date Sampled	On-site Mobile Lab	On-site Mobile Lab	On-site Mobile Lab
MW-7	9/24/2017	2 U	2 U	2 U
VSB-46-49	9/28/2017	**13.8/14.9**	2 U/2U	2 U/2U
VSB-46-54	9/28/2017	2 U	2 U	2 U
VSB-46-59	9/28/2017	2 U	2 U	2 U
VSB-47-49	9/28/2017	2 U	2 U	2 U
VSB-47-55	9/28/2017	2 U	2 U	2 U
VSB-47-60	9/29/2017	2 U	2 U	2 U
VSB-48-50	9/29/2017	2 U	2 U	2 U
VSB-48-55	9/29/2017	2 U	2 U	2 U
VSB-48-60	9/29/2017	2 U	2 U	2 U
VSB-49-50	9/29/2017	2 U	2 U	2 U
VSB-49-55	9/29/2017	2 U	2 U	2 U
VSB-49-60	9/29/2017	2 U	2 U	2 U

* Potentially diluted - re-run with 'A' designation

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

[2] screening levels for cis-1,2-DCE shown here. It is the lower of the cis and trans isomer RSLs.

[3] screening levels for VC shown here.

MCL: Maximum Contaminant Level; U: not detected; USEPA: U.S. Environmental Protection Agency; µg/L: micrograms per liter; DCA: dichloroethane; DCE: dichloroethene (sum of cis-1,2-DCE and trans-1,2-DCE); TCE: trichloroethene; VC: vinyl chloride

Table 5. Comparision of analytical results in soil samples analyzed by the on-site mobile laboratory and the off-site QA laboratory

	Analyte	TCE		DCE	cis-1,2-DCE	trans-1,2-DCE	VC+1,2 DCA	Vinyl Chloride
	Units	(mg/kg)		(mg/kg) [2]	(mg/kg)	(mg/kg)	(mg/kg) [3]	(mg/kg)
	USEPA Residential Soil RSL [1]	0.41		16	16	160	0.059	0.059
	MDEQ Groundwater Protection Criterion	0.1		1.4	1.4	14	0.04	0.04
Sample Name	Date Sampled	On-site Mobile Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab
VSB-35-22.5	9/18/2017	0.010U	0.0052U	0.010U	0.0052U	0.0052U	0.010U	0.0052U
VSB-35-25	9/18/2017	0.009U/ 0.009U	0.0055U/ 0.0011U	0.009U/ 0.009U	0.0055U/ 0.0011U	0.0055U/ 0.0011U	0.009U/ 0.009U	0.0055U/ 0.0011U
VSB-38-2.5	9/23/2017	0.008U	0.00082U	0.008U	0.00082U	0.00082U	0.008U	0.00082U
VSB-38-5	9/23/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U
VSB-38-7.5	9/23/2017	0.009U	0.0011U/ 0.0013U	0.009U	0.0011U/ 0.0013U	0.0011U/ 0.0013U	0.009U	0.0011U/ 0.0013U
VSB-38-10	9/23/2017	0.010U	0.0011U	0.010U	0.0011U	0.0011U	0.010U	0.0011U
VSB-38-12.5	9/23/2017	0.011U	0.0012U	0.011U	0.0012U	0.0012U	0.011U	0.0012U
VSB-38-15	9/24/2017	0.011U	0.00099U	0.011U	0.00099U	0.00099U	0.011U	0.00099U
VSB-39-12.5	9/21/2017	0.074U	**0.00055J/ 0.000831J**	**3.050**	**6.2/ 11.1**	**1.35/ 3.93**	0.074U	**0.0346J/ 0.0276**
VSB-39-13	9/21/2017	0.162U	**1.34**	**13.683**	**23.5**	**8.72**	0.162U	**0.0897**
VSB-39-14	9/22/2017	0.010U	**0.00512**	0.010U	**0.00824**	**0.00251**	0.010U	0.001U
VSB-41-2.5	9/22/2017	0.008U	0.0012U	0.008U	0.0012U	0.0012U	0.008U	0.0012U
VSB-41-5	9/22/2017	0.004U	0.0011U	0.004U	0.0011U	0.0011U	0.004U	0.0011U
VSB-41-7.5	9/22/2017	0.008U	0.0011U	0.008U	0.0011U	0.0011U	0.008U	0.0011U
VSB-41-8-14	9/22/2017	0.008U	0.0011U	0.008U	0.0011U	0.0011U	0.008U	0.0011U
VSB-41-24.5	9/23/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U
VSB-46-2.5	9/28/2017	0.014U	0.0011U	0.014U	0.0011U	0.0011U	0.014U	0.0011U
VSB-46-5	9/28/2017	0.008U	0.0011U	0.008U	0.0011U	0.0011U	0.008U	0.0011U
VSB-46-10	9/28/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U
VSB-46-12.5	9/28/2017	0.012U	0.0011U	0.012U	0.0011U	0.0011U	0.012U	0.0011U
VSB-46-15	9/28/2017	0.007U	0.0013U	0.007U	0.0013U	0.0013U	0.007U	0.0013U

Table 5. Comparision of analytical results in soil samples analyzed by the on-site mobile laboratory and the off-site QA laboratory

	Analyte	TCE		DCE	cis-1,2-DCE	trans-1,2-DCE	VC+1,2 DCA	Vinyl Chloride
	Units	(mg/kg)		(mg/kg) [2]	(mg/kg)	(mg/kg)	(mg/kg) [3]	(mg/kg)
	USEPA Residential Soil RSL [1]	0.41		16	16	160	0.059	0.059
	MDEQ Groundwater Protection Criterion	0.1		1.4	1.4	14	0.04	0.04
Sample Name	Date Sampled	On-site Mobile Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab
VSB-47-2.5	9/28/2017	0.014U	0.0012U	0.014U	0.0012U	0.0012U	0.014U	0.0012U
VSB-47-5	9/28/2017	0.008U	0.0015U	0.008U	0.0015U	0.0015U	0.008U	0.0015U
VSB-47-7.5	9/28/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U
VSB-47-10	9/28/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U
VSB-47-12.5	9/28/2017	0.008U	0.0013U	0.008U	0.0013U	0.0013U	0.008U	0.0013U
VSB-48-2.5	9/29/2017	0.011U	0.0011U	0.011U	0.0011U	0.0011U	0.011U	0.0011U
VSB-48-5	9/29/2017	0.019U	0.0015U	0.019U	0.0015U	0.0015U	0.019U	0.0015U
VSB-48-7.5	9/29/2017	0.010U	0.0012U	0.010U	0.0012U	0.0012U	0.010U	0.0012U
VSB-48-10	9/29/2017	0.010U	0.0011U	0.010U	0.0011U	0.0011U	0.010U	0.0011U
VSB-48-12.5	9/29/2017	0.009U	0.0011U/ 0.001U	0.009U	0.0011U/ 0.001U	0.0011U/ 0.001U	0.009U	0.0011U/ 0.001U
VSB-49-2.5	9/29/2017	0.011U	0.001U	0.011U	0.001U	0.001U	0.011U	0.001U
VSB-49-5	9/29/2017	0.010U	0.0014U	0.010U	0.0014U	0.0014U	0.010U	0.0014U
VSB-49-7.5	9/29/2017	0.010U	0.0013U	0.010U	0.0013U	0.0013U	0.010U	0.0013U
VSB-49-10	9/29/2017	0.012U	0.0011U	0.012U	0.0011U	0.0011U	0.012U	0.0011U
VSB-49-12.5	9/29/2017	0.009U	0.0011U	0.009U	0.0011U	0.0011U	0.009U	0.0011U

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

[2] screening levels for cis-1,2-DCE shown here. It is the lower of the cis and trans isomer RSLs.

[3] screening levels for VC shown here.

J: Estimated; MDEQ: Michigan Department of Environmental Quality; mg/kg: milligram per kilogram; RSL: Regional Screening Level;

U: not detected; USEPA: U.S. Environmental Protection Agency;

cis-1,2-DCE: cis-1,2-dichloroethene; DCA: dichloroethane; DCE: dichloroethene (sum of cis- and trans-1,2-DCE); TCE: trichloroethene; trans-1,2-DCE: trans-1,2-dichloroethene; VC: vinyl chloride

Table 6. Comparision of analytical results in groundwater samples analyzed by the on-site mobile laboratory and the off-site QA laboratory

	Analyte	TCE		DCE [2]	cis-1,2-DCE	trans-1,2-DCE	VC+1,2 DCA [3]	Vinyl Chloride
	Units	(µg/L)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
	USEPA MCL [1]	5		70	70	100	2	2
Sample Name	Date Sampled	On-site Mobile Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab	Off-site QA Lab	On-site Mobile Lab	Off-site QA Lab
VSB-38-60	9/21/2017	**26.2**	**21**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-38-70	9/21/2017	2 U	**1.4**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-40-61*	9/22/2017	2 U	**10**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-43-49	9/24/2017	2 U	**0.020 J**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-44-46	9/24/2017	2 U	**0.17**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-45-46	9/24/2017	2 U	**1.1**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-46-49	9/28/2017	**13.8**	**16**	2 U	0.050 U	0.050 U	2 U	0.050 U
VSB-48-55	9/29/2017	2 U	**0.11**	2 U	0.050 U	0.050 U	2 U	**0.028 J**

* Potentially diluted - re-run with 'A' designation

[1] USEPA RSL, May 2016, Target Risk of 1x10-6, target hazard of 0.1.

[2] screening levels for cis-1,2-DCE shown here. It is the lower of the cis and trans isomer RSLs.

[3] screening levels for VC shown here.

J: Estimated; MCL: Maximum Contaminant Level; QA: Quality Assurance; U: not detected; USEPA: U.S. Environmental Protection Agency; µg/L: micrograms per liter

cis-1,2-DCE: cis-1,2-dichloroethene; DCA: dichloroethane; DCE: dichloroethene (sum of cis- and trans-1,2-DCE); TCE: trichloroethene; trans-1,2-DCE: trans-1,2-dichloroethene;

VC: vinyl chloride

ATTACHMENT 5: PRELIMINARY BORING LOGS

Print Form | E-mail

DRILLING LOG *(Continuation Sheet)*
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.

1. ELEVATION TOP OF HOLE

2. HOLE NUMBER: VSB-35

SHEET ____ OF ____ SHEETS

3. PROJECT: Raco

4. INSTALLATION

5. ELEVATION	a. DEPTH	b. LEGEND	c. CLASSIFICATION OF MATERIALS *(Description)*	d. % CORE RECOVERY	e. BOX OR SAMPLE NUMBER	f. REMARKS *(Drilling Time, water loss, depth of weathering, etc., if significant)*
		1'	Blind	%		
		2'		%		
		3'		%		
		4'		%		
		5'		%		

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6. PROJECT

7. HOLE NUMBER

VERSION 1.0

Print Form | E-mail

DRILLING LOG *(Continuation Sheet)* For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.	1. ELEVATION TOP OF HOLE	2. HOLE NUMBER VSB-35	SHEET ____ OF ____ SHEETS
3. PROJECT		4. INSTALLATION	

5. ELEVATION	a. DEPTH	b. LEGEND	c. CLASSIFICATION OF MATERIALS *(Description)*	d. % CORE RECOVERY	e. BOX OR SAMPLE NUMBER	f. REMARKS *(Drilling Time, water loss, depth of weathering, etc., if significant)*
				%		
				%		
		6		%		
				%		
		7	Blind	%		
				%		
		8		%		
				%		
		9		%		
				%		
		10		%		

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6. PROJECT | 7. HOLE NUMBER

VERSION 1.0

Print Form | E-mail

DRILLING LOG *(Continuation Sheet)* For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.	1. ELEVATION TOP OF HOLE	2. HOLE NUMBER VSB-35	SHEET ____ OF ____ SHEETS
3. PROJECT		4. INSTALLATION	

5. ELEVATION	a. DEPTH	b. LEGEND	c. CLASSIFICATION OF MATERIALS *(Description)*	d. % CORE RECOVERY	e. BOX OR SAMPLE NUMBER	f. REMARKS *(Drilling Time, water loss, depth of weathering, etc., if significant)*
				%		
				%		
		11		%		
				%		
		12		%		
				%		
		13		%		
				%		
		14		%		
				%		
		15		%		

Blind

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6. PROJECT | 7. HOLE NUMBER

VERSION 1.0

Print Form | E-mail

DRILLING LOG *(Continuation Sheet)* For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.	1. ELEVATION TOP OF HOLE	2. HOLE NUMBER	SHEET ____ OF ____ SHEETS
3. PROJECT		4. INSTALLATION	

5. ELEVATION	a. DEPTH	b. LEGEND	c. CLASSIFICATION OF MATERIALS *(Description)*	d. % CORE RECOVERY	e. BOX OR SAMPLE NUMBER	f. REMARKS *(Drilling Time, water loss, depth of weathering, etc., if significant)*
			Fine Sand, some silt, Backfill/ disturbed material from previous digging dry, loose	100 % 15'-20'	PID 0	1127 - 1135 for 15'-20' run.
				%		
		16				
				%		
				%		
					PID 0	
		17		%		
						sample at 17.5' VSB-35-17.5
				%		
		18		%		
				%		
					PID 0	
		19		%		
				%		
			A A			Sample at 20' VSB-35-20
		20		%	PID 0	

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6. PROJECT | 7. HOLE NUMBER

VERSION 1.0

Print Form | E-mail

DRILLING LOG *(Continuation Sheet)*
For use of this form, see EM 1110-1-1804; the proponent agency is CECW-EG.

1. ELEVATION TOP OF HOLE:

2. HOLE NUMBER: VSB-35

SHEET ____ OF ____ SHEETS

3. PROJECT: Raco

4. INSTALLATION:

5. ELEVATION	a. DEPTH	b. LEGEND	c. CLASSIFICATION OF MATERIALS (Description)	d. % CORE RECOVERY	e. BOX OR SAMPLE NUMBER	f. REMARKS (Drilling Time, water loss, depth of weathering, etc., if significant)
			Very Fine Grained Sand, little silt, loose, dry.	55 %		1135-1154 20'-25' run
				%		liner was stuck in tube, could not extract full core
		21		%		
				%		
		22		%		Sample 22.5' VSB-35-22.5
				%		
		23		%		
				%		
		24		%		
				%		
			A A	%		Sample 25' VSB-35-25
		25				

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6. PROJECT

7. HOLE NUMBER

VERSION 1.0

HTW DRILLING LOG

HOLE NO. VSB-38

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF SHEETS	1
3. PROJECT	Raco
4. LOCATION	Raco, ME
5 NAME OF DRILLER	Nick Moreno
6. MANUFACTURER'S DESIGNATION OF DRILL	GEO Probe 8040 DT
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	3.25" Casing 2.25" Core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-23-17
11. DATE COMPLETED	9-24-17
12 OVERBURDEN THICKNESS	30'
15. DEPTH GROUNDWATER ENCOUNTERED	NA
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	30'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
			—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	11					100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			Ray Fagan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil with roots, sandy	PID 0	0-5 recovery 100%			
	1 2	SAND, dark brown, fine grained, subrounded, low compaction, moderatly sorted, dry	PID 0				Sample VSB-38-2.5 @ 1316
	3	~~GRAVEL~~ SANDY GRAVEL, Gravel to 1.5" mixed with sand, appears to be a leach field	PID 0				
	4 5	SAND, ~~Dark~~ brown, fine ~~grained~~, sub rounded, low compaction, dry, moderate ~~sorting~~	PID 0				Sample VSB-38-5 @ 1321

PROJECT | HOLE NO.

FORM MRK JUN 89 55

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-38

PROJECT

INSPECTOR

SHEET OF SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		A A	PID 0	5-10 recovery 100%			
	6						
			PID 0				
	7						sample VSB-38-7.5 @1323
			PID 0				
	8						
	9						
			PID 0				Sample VSB-38-10 @1337
	10	A A		10-15 Recovery 100%			
	11						
			PID 0				
	12						sample VSB-38-12.5 @1339
	13	Becoming lighter in color	PID 0				
	14						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-38

PROJECT

INSPECTOR

SHEET OF SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. i	BLOW COUNTS g	REMARKS h
	15	A A	PID 0		—	—	Sample VSB-38-15 @0945
				15-20 recovery 100%			
	16		PID 0				
	17				—	—	Sample VSB-38-17.5 @0947
	18		PID 0				
	19						
	20		PID 0		—	—	Sample VSB-38-20 @1007
				20-25 recovery 100%			
	21						
	22	A A	PID 0				
					—	—	Sample VSB-38-22.5 @1009
	23						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-38

PROJECT

INSPECTOR

SHEET OF SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
	24		PID 0				
	25			25-30 recovery 100%			Sample VSB-38-25 @ 1025
		trace course sand more poorly sorted	PID 0				
	26						
	27						
			PID 0				Sample VSB-38-27.5 @ 1027
	28						
	29	Increasing course sand grains	PID 0				
	30						
		Bottom of hole 30'					
	31						
			~~PID 0~~				
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-39

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF 1 SHEETS 3	
3. PROJECT	Raco
4. LOCATION	Vault 4 South
5 NAME OF DRILLER	Nick Moreno
6. MANUFACTURER'S DESIGNATION OF DRILL	GEOProbe 8040 DT
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	3.25" Macro Core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-21-17
11. DATE COMPLETED	9-22-17
12 OVERBURDEN THICKNESS	16.5'
15. DEPTH GROUNDWATER ENCOUNTERED	NA
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	16.5'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
			—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	2					68 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	1	Blind					Started 9-22-17
	2						
	3						
	4	SAND, backfill, Soft, moist.	30% Recovery 3'-8'				Disturbed backfill From digging in vault 4
	5						Sample VSB-39-5

PROJECT

HOLE NO.

FORM MRK JUN 89 55

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-39

PROJECT Raco

INSPECTOR Ray Fox

SHEET OF 2 SHEETS 3

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	6	A A					
	7						~~Sample VSB-39-7.5~~
	8	SAND, Dark brown, very wet, subangular, Fine, some silt.	100% Recovery 8'-13'	PID 0			Strong odor, very dark,
	9			PID 0			
	10			PID 8			Sample VSB-39-10
	11	little gravel, very wet, nearly black.		PID 14			
	12	Concrete pieces, mixed with black sludge		PID 25.4			Sample VSB-39-12.5 Fractured concrete
	13	Concrete pieces and sand mixed	13'-16.5' recovery 75%	PID 122 @ 13.2'			Resumed at 13' on 9-22-17 Sample VSB-39-13
	14	Fine grained sand (Cont. next page)					Sample VSB-39-14

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-39

PROJECT Raco

INSPECTOR Ray Fr

SHEET OF 3 SHEETS 3

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		SAND, Tan, Fine grained, little silt, sub angular, low compaction, Dry. (SP)	PID 0.7				
	15						
							Sample VSB-39-16
	16		PID 0				Appeared to hit Concrete, or solid bottom at 16.5'
		Bottom of boring 16.5'					
	17						
	18						
	19						
	20						
	21						
	22						
	23						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-41

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF 1 SHEETS 6	
3. PROJECT	Raco
4. LOCATION	Raco, MI
5 NAME OF DRILLER	Nick Moreno
6. MANUFACTURER'S DESIGNATION OF DRILL	GEO Probe 8040 DT
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	3.25" Casing; 2.25" Core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-22-17
11. DATE COMPLETED	9-23-17
12 OVERBURDEN THICKNESS	43'
15. DEPTH GROUNDWATER ENCOUNTERED	NA
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	43'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	17					72 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil w/ roots	PID 0	0-3 recovery 100%			
	1	SAND, ~~light~~ Dark tan, Fine grained, subrounded to sub angular, moderatly sorted, low compaction, dry (SW)		1430			
	2		PID 0				
							Sample VSB-41-2.5
	3	SAND, light tan, some gravel + 3/8", subrounded sand and gravel, poorly sorted, low compaction, dry (SP)	PID 0				
				3-8 recovery 100%			
	4		PID 0				
	5	Gravel + 3/4"					

FORM MRK JUN 89 55 | PROJECT | HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-41

PROJECT Raco

INSPECTOR Roger Fay

SHEET 6 OF 2 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		AA	PID 0				Sample VSB-41-5 (1445)
	6	Sand, light tan, fine grained moderately sorted, low compaction, sub-rounded, dry (SP)	PID 0				
		much higher compaction					
	7	granite cobble broken by drill					
	8	SAND, light tan, very fine grained, little silt, subrounded, moderately sorted, dry	PID 0	8-13 Recovery 0%			Sample VSB-41-7.5 (1447) Core was stuck in the liner and had to be pushed out into a bag.
	9						
	10		PID 0				Sampled one foot 8-13 @1538
	11						
	12		PID 0				
	13	AA		13-16.5 Recovery 100%			Sample VSB-41- @1553
	14						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB 41

PROJECT Raco

INSPECTOR Ray Tage

SHEET 3 OF 3 SHEETS 6

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
			PID 0				Sample VSB-41-15 @1554
	15	Trace gravel	PID 0				Sample VSB-41-16 ~~VSB-41-18~~ @1623
	16		PID 0	16.5-18 recovery 100%			
	17		PID 0.3				Sample VSB-41-18 @1624
	18	A A	PID 0	18'-23' recovery 30%			
	19						
	20		PID 0				Sample VSB-41-20
	21						
	22		PID 0				Sample VSB-41-22
	23						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-41

PROJECT Raco

INSPECTOR [illegible]

SHEET 4 OF 4 SHEETS 6

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0	23'-28' recovery 100%			
		AA					
	24						
			PID 0				Sample VSB-41-24.5 @0815
	25						
			PID 0				
	26	More compact					Sample becomes noticably more compact at 26'
	27		PID 0				Sample VSB 41-27 @0817
	28						
			PID 0				
		large piece of gravel about 1.5"					
	29						Sample VSB-41-29.5 @ 0825
		another 1.5" piece of gravel					
	30		PID 0				
	31						
			PID 0				Sample VSB 41-32 @ 0827
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-41

PROJECT Raco

INSPECTOR [illegible]

SHEET 5 OF 5 SHEETS 6

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	33		PID 0	33-38 recovery 100%			
	34		PID 0				Sample VSB-41-34.5 @ 0845
		Trace gravel to 0.25"					
	35	No gravel	PID 0				
	36		PID 0				
	37						Sample VSB-41-37 @ 0847
			PID 0				
	38		PID 0	38'-43' recovery 100%			
	39	More gravel, gravel to 1/4"					Sample VSB-41-39.5 @ 0902
	40		PID 0				
		No gravel					
	41						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-41

PROJECT Raco

INSPECTOR Ray [illegible]

SHEET 6 OF 6 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		A A	PID 0				Sample VSB-41-42 @0904
	42						
			PID 0				
	43	Bottom of hole 43'					
	44						
	45						
	46						
	47						
	48						
	49						
	50						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-42

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF 1 SHEETS 2	
3. PROJECT	Raco
4. LOCATION	North Side of Vault 4
5 NAME OF DRILLER	Nick Moreno
6. MANUFACTURER'S DESIGNATION OF DRILL	GeoProbe 8040 DT
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	~~22~~ MCS Macro Core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-24-17
11. DATE COMPLETED	9-24-17
12 OVERBURDEN THICKNESS	13.5'
15. DEPTH GROUNDWATER ENCOUNTERED	NA
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	13.5'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	1					27 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	1	BLIND					
	2						
	3						
	4	Backfill, Sand with topsoil, roots and gravel.	NA	3-8 recover 25%			No sample in first core
	5						

FORM MRK JUN 89 55

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-42

PROJECT

INSPECTOR

SHEET OF 2 SHEETS 2

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
	6						
	7						
	8	Sludge, Black, very wet, some fibers.	PID 54.5	8-13.5 recovery 30%			Strong Chemical Odor, like Petrolium or Cleaner.
	9						
	10						
	11						
	12		PID 54.5				Sample VSB-42-13 @ 0915
	13						
	14	Bottom of hole 13.5'					

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-46

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF 1 SHEETS 8	
3. PROJECT	Raco
4. LOCATION	
5 NAME OF DRILLER	Larry Humsbarger
6. MANUFACTURER'S DESIGNATION OF DRILL	Boart-Longyear Sonic
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6" casing 4" core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-28-17
11. DATE COMPLETED	9-28-17
12 OVERBURDEN THICKNESS	60'
15. DEPTH GROUNDWATER ENCOUNTERED	46.5'
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	60'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	20					95 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			Ramy Fage

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil with roots	PID 0	0-10' recovery 50%			Only recovered 50%, 3 ft. fell on the ground.
	1	SAND, Tan, Some gravel to 3/8", subrounded, low compaction, poorly sorted, dry	PID 0				
	2				VSB-46-2.5 @ 1003		Sample VSB-46-2.5
	3		PID 0				
	4		PID 0				
	5				VSB-46-5 @ 1007		Sample VSB-46-5

FORM MRK JUN 89 55

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 2 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
			PID 0				
	6						
	7						
	8		PID 0				~~Sample VSB-46-7.5~~
	9						
	10	SAND, Tan, Fine grained, moderatly sorted, subrounded, low compaction, dry	PID 0	10'-15' recovery 100%	VSB-46-10 @ 1018		~~Sample~~
	11						
	12						
	13		PID 0		VSB-46-12.5 @ 1018		
	14						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR Roger Fuge

SHEET 3 OF 3 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
	15		PID 0	15'-20' recovery 100%	VSB-46-15 @ 1019		
	16						
	17				VSB-46-17.5 @ 1022		
	18	little gravel, more poorly sorted, becoming more fine grained	PID 0				
	19						
	20			20'-25' recovery 100%	VSB-46-20 @ 1023		
	21		PID 0				
	22	very fine grained, no gravel			VSB-46-22.5 @ 1032		
	23						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR Ramy Fayez

SHEET OF 4 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0				
	24						
	25		PID 0	25'-30' recovery 100%	VSB-46-25 @ 1033		
	26						
	27	Fine to medium grained, little gravel, damp			VSB-46-27.5 @ 1037		
	28		PID 0				
	29						
	30			30'-35' Recovery 100%	VSB-46-30 @ 1038		
	31	No gravel, becoming finer grained.	PID 0				
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR Ronny Fagan

SHEET 5 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID 0		VSB-46-32.5 @ 1051		
	33						
	34						
	35	Trace gravel, becoming finer, dry		35'-40' recovery 100%	VSB-46-35 @ 1052		
	36						
	37				VSB-46-37.5 @ 1058		
	38						
		very fine grained, trace silt, better sorted					
	39						
	40			40'-45' recovery 100%	VSB-46-40 @ 1059		
	41						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR

SHEET OF 6 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID 0				
	42				VSB-46-42.5 @1115		
	43	Fine grained, darker brown, damp					
	44	very fine grained back to light tan	PID 0				
	45	moist		45'-50' 100% recovery	VSB-46-45 @1116		
	46						▽
	47	WeT, little silt at the top of the water table					
	48		PID 0				
	49						
	50				GW Sample VSB-46-49 @1318		

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR Ronny Fagan

SHEET 7 OF 7 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID 0	50'-56' recovery 100%	VSB-46-50 @ 1354 Inferred	GW	attempting infered GW from soil at 50'
	51	less silt					
	52						
	53		PID 0				
	54				GW Sample VSB-46-54 @ 1331		
		A A					
	55			55'-60' recovery 100%			
	56		PID 0				
	57						
	58	AA					
			PID 0				
	59						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-46

PROJECT Raco

INSPECTOR [illegible]

SHEET 8 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID0				
		A A			Gw Sample VSB-46-SQ @ 1404		
	60	Bottom of Hole 60'					
	61						
	62						
	63						
	64						
	65						
	66						
	67						
	68						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-47

1 COMPANY NAME: GEO Consultants	2. DRILLING SUBCONTRACTOR: Cascade
SHEET 1 OF 1 SHEETS 8	
3. PROJECT: Raco	4. LOCATION: Raco, MI
5 NAME OF DRILLER: Larry Humsbdsger	6. MANUFACTURER'S DESIGNATION OF DRILL: Boart-Longyear Sonic
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4" Core; 6" Casing	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED: 9-28-17
	11. DATE COMPLETED: 9-29-17
12 OVERBURDEN THICKNESS: 60'	15. DEPTH GROUNDWATER ENCOUNTERED: 46'
13 DEPTH DRILLED INTO ROCK: 0'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA
14 TOTAL DEPTH OF HOLE: 60'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	X					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil with roots		0'-5' recovery 100%			
	1	SAND, little gravel to ¼", Tan, subrounded, medium grained to fine grained, Poorly sorted, dry.	PID 0				
	2				VSB-47-2.5 @ 1535		
	3		PID 0				
	4						
	5		PID 0		VSB-47-5 @ 1534		

FORM MRK JUN 89 55

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 2 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID	5'-10' recovery 100%			
	6	SILTY SAND, dark brown, medium-fine grained, light compaction, subrounded, dry, Glacial outwash	0				hard silt
	7	SAND, light tan, some gravel and cobbles to 3.5", medium to fine grained, low compaction, subrounded, dry	PID 0		VSB-47-7.5 @ 1537		
	8	No gravel, fine grained					
	9						
	10	Dark tan, very fine grained	PID 0	10'-15' recovery 100%	VSB-47-10 @ 1538		
	11	more course, medium to fine grained					
	12				VSB-47-12.5 @ 1544		
	13		PID 0				
	14						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT Raco

INSPECTOR Randy Fagan

SHEET 3 OF 3 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0				
	15			15'-20' recovery 100%	VSB-47-15 @ 1545		
	16	SILT, brownish-gray, little sand and gravel, firm, low compaction moist	PID 0				
	17	SAND, fine grained, tan, sub-rounded, low compaction, moderatly sorted, dry			VSB-47-17.5 @ 1557		
	18		PID 0				
	19						
	20			20'-25' recovery 100%	VSB-47-20 @ 1558		
	21	medium grained, subrounded to rounded low compaction, poorly sorted, dry	PID 0				
	22				VSB-47-22.5 @ 1600		
	23						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT Raco

INSPECTOR Ronny Fuqua

SHEET 8 OF 4 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Fine grained, sub-rounded to subangular, low-compaction Poorly sorted, dry	PID 0				
	24						
			PID 0	25'-30' recovery 100%	VSB-47 @ 1601	-25	
	25						
	26						
	27		PID 0		VSB-47 @ 1605	-27.5	
	28						
	29						
	30		PID 0	30'-35' recovery 100%	VSB-47 @ 1606	-30	
	31	Medium grained, sub rounded, low compaction, poorly sorted dry					
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB - 47

PROJECT Raco

INSPECTOR Ray Fagan

SHEET 5 OF 5 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
					VSB-47-32.5 @ 1622		
	33	Fine grained, sub-rounded to sub angular, low comp. Poorly sorted, dry	PID 0				
	34						
	35			35'-40' recovery 100%	VSB-47-35 @ 1623		
	36		PID 0				
	37				VSB-47-37.5 @ 1629		
	38						
	39	becoming finer	PID 0				
	40			40'-45' Recovery 100%	VSB-47-40 @ 1630		
	41						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT Raco

INSPECTOR [illegible]

SHEET 6 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	42	Very Fine, damp	PID 0				
					VSB-47-42.5 @ 1652		
	43						
		Damp					
	[illegible]	Moist					
	45		PID 0	45'-50' recovery 20%	VSB-47-45 @ 1653		45'-50' sample fell out of sampler.
	46	Wet ▽					Water at 46'
	[illegible]						
	48						
	49				GW Sample VSB-47-49 @ 1702		
	[illegible]						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT Raco

INSPECTOR [illegible]

SHEET 8 OF 7 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0.				
	51	little gravel to 1/4"					
	52		PID 0				
	53						
	54	no gravel					
	55		PID. 0				
	56						
	57		PID 0				
	58						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-47

PROJECT

INSPECTOR

SHEET OF ~~6~~ SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. i	BLOW COUNTS g	REMARKS h
		AA			GW sample VSB-47-60 @ 08[illegible]		
	60	Bottom of hole 60'					
	61						
	62						
	63						
	64						
	65						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-48

1 COMPANY NAME GEO Consultants	2. DRILLING SUBCONTRACTOR Cascade
SHEET 1 OF 1 SHEETS	
3. PROJECT Raco	4. LOCATION Raco, MI
5 NAME OF DRILLER Larry Hunsberger	6. MANUFACTURER'S DESIGNATION OF DRILL Boart - Longyear Sonic
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 6" casing; 4" core	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED 9-29-17 / 11. DATE COMPLETED 9-29-17
12 OVERBURDEN THICKNESS 60'	15. DEPTH GROUNDWATER ENCOUNTERED 46'
13 DEPTH DRILLED INTO ROCK 0'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED NA
14 TOTAL DEPTH OF HOLE 60'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	20					94 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil with roots	PID 0	0-5' recovery 100%			
	1	SAND, Brown, fine grained, little gravel to 1/4", sub-rounded, loose, dry, moderately sorted					
	2	Medium grained with some gravel, loose, poorly sorted, dry	PID 0		VSB-48-2.5 @ 0953		
	3						
	4	Fine grained sand, little gravel, loose, poorly sorted, dry	PID 0				
	5				VSB-48-5.5 @ 0954		

FORM MRK JUN 89 55

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET 2 OF 2 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0	5'-10' recovery 100%			
	6	NO gravel					
	7	little gravel to 1.5"	PID 0				
		No gravel			VSB-48-7.5 @0959		
	8	SILTY SAND, Loose, Pulverized silt with fine grained sand, dry, poorly sorted, light gray	PID 0				
	9	SAND, fine grained, little gravel, low compaction, poorly sorted, dry, light brown					
	10	SILTY SAND, brown, hard silt, low compaction, poorly sorted, dry	PID 0		VSB-48-10 @1000		
				10'-15' recovery 100%			
	11	SAND, fine grained, tan, low compaction, moderatly sorted, subrounded, dry					
	12		PID 0		VSB-48-12.5 @ 1003		
	13						
	14						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 3 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
				PID 0			
	15		15'-20' recovery 100%		VSB-48-15 @ 1006		
		SILT, Gray brown, firm, no cohesion					
	16	SAND, fine grained, low compaction, poorly sorted, subrounded, dry		PID 0			
	17				VSB-48-17.5 @ 1009		
	18						
	19			PID 0			
	20		20'-25' recovery 100%		VSB-48-20 @ 1010		
	21						
		some cobbles to 3.5" and gravel to 2"					
	22			PID 0			
					VSB-48-22.5 @ 1021		
	23	no cobbles or gravel					

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 4 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0				
	24						
	25	little gravel to 1"		25'-30' recovery 100%	VSB-48-25 @ 1022		
			PID 0				
	26						
	27	little silt					
					VSB-48-27.5 @ 1035		
	28						
			PID 0				
	29						
	30	more coarse		30'-35' recovery 100%	VSB-48-30 @ 1036		
	31						
			PID 0				
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET 5 OF 5 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
					VSB-48-32.5 @ 1040		
		Becoming finer					
	33						
			PID 0				
	34						
	35	Becoming coarser		35'-40' recovery 100%	VSB-48-35 @ 1040		
		some cobbles to 2.5"	PID 0				
	36						
		no cobbles					
	37						
					VSB-48-37.5 @ 1220		
	38						
			PID 0				
	39						
	40	Dolomite erratic					
		SAND, tan, fine grained, low compaction, sub-rounded, poorly sorted, dry	PID 0	40'-45' recovery 100%	VSB-48-40 @ 1221		
	41						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET 6 OF 8 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		A A					
	42						
					VSB-48-42.5 @ 1232		
	43						
	44						
	45	A A			VSB-48-45 @ 1233		
		Damp		45'-50' recovery 30%			most of core appears to have fallen from barrell on 45'-50' core.
	46	wet ▽					water at 46'
	47						
	48						
	49	A A					
					GW Sample VSB-48-50 @ 1240		
	50						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 7 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		AA	PID 0	50'-55' recovery 100%			
	51						
	52						
	53		PID 0				
	54						
	55				VSB-48-55 @1332		
	56						
	57		PID 0				
	58						
	59						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-48

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 8 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
		AA	PID 0		VSB-48-60 @ 1420		
	60	Bottom of hole 60'					
	61						
	62						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG

HOLE NO. VSB-49

1 COMPANY NAME	GEO Consultants
2. DRILLING SUBCONTRACTOR	Cascade
SHEET 1 OF 1 SHEETS 8	
3. PROJECT	Raco
4. LOCATION	Raco, MI
5 NAME OF DRILLER	Larry Humsberger
6. MANUFACTURER'S DESIGNATION OF DRILL	Boart-Longyear Sonic
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	6" Casing; 4" Core
8. HOLE LOCATION	
9. SURFACE ELEVATION	
10. DATE STARTED	9-29-17
11. DATE COMPLETED	9-29-17
12 OVERBURDEN THICKNESS	60'
15. DEPTH GROUNDWATER ENCOUNTERED	46'
13 DEPTH DRILLED INTO ROCK	0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14 TOTAL DEPTH OF HOLE	60'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	—	—	—

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	20					100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			[signature]

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		Topsoil with roots	PID 0	0'-5' recovery 100%			grass and roots
	1	SAND, fine grained, some gravel to 1", loose, sub-rounded to sub angular, Poorly Sorted, dry					
	2	medium grained	PID 0		VSB-49-2.5 @ 1545		
	3	No gravel					
		SANDY SILT, Firm, dark brown, no cohesion, dry					
	4	SAND, fine to medium grained loose, sub rounded, Tan, Poorly sorted, dry	PID 0		VSB-49-5 @ 1546		
	5						

FORM MRK JUN 89 55

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 2 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
				5'-10' recovery 100%			
	6	much finer, rounded to sub-rounded, some gravel to 3/8", dark brown	PID 0				
	7	Tan, fine grained, no gravel			VSB-49-7.5 @ 1549		
	8		PID 0				
	9						
	10	little gravel	PID 0	10'-15' recovery 100%	VSB-49-10 @ 1550		
	11						
		no gravel					
	12						
	13		PID 0				
	14	little silt					

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET 3 OF 3 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		A A					
	15		PID 0	15'-20' recovery 100%	VSB-49-15 @ 1558		
	16						
	17		PID 0		VSB-49-17.5 @ 1602		
	18	increasing silt					
	19		PID 0				
	20			20'-25' recovery 100%	VSB-49-20 @ 1603		
	21	little silt	PID 0				
	22						
	23				VSB-49-22.5 @ 1615		

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 4 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
			PID 0				
		A A					
	24						
	25	little gravel to 1/4"		25'-30' recovery 100%	VSB-49-25 @ 1616		
			PID 0				
	26						
	27						
					VSB-49-27.5 @ 1619		
	28		PID 0				
		no gravel					
	29						
							Broken rod when recovering last sample, all tooling recovered
	30				VSB-49-30 @ 1620		
	31	little gravel					
			PID 0				
	32						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR Ray Fox

SHEET 5 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
			PID 0		VSB-49-32.5 @1642		
	33						
	34	No gravel					
	35		PID 0	35-40' recovery 100%	VSB-49-35 @1643		
	36						
		more Coarse					
	37		PID 0		VSB-49-37.5 @1649		
	38						
	39						
	40		PID 0	40'-45' recovery 100%	VSB-49-40 @1650		
	41						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET 6 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h
			PID 0				
	42				VSB-49-42.5 @1705		
		increasing silt					
	43		PID 0				
	44						
		small balls of silt					
	45	Damp		45'-50' recovery 75%	VSB-49-42.5 @1706		
	46	Wet ▽	PID 0				▽ water at 46'
	47						
	48		PID 0				
	49	A A					
	50				GW sample VSB-49-50 @1717		

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET OF 7 SHEETS 8

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
		AA	PID 0	50'-55' recovery 75%			
	51						
	52						
	53		PID 0				
	54						
		AA					
	55				GW sample VSB-49-55 @ 1749		
	56						
			PID 0				
	57						
	58						
		AA					
	59						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

HTW DRILLING LOG (CONT.)

HOLE NO. VSB-49

PROJECT Raco

INSPECTOR [illegible]

SHEET 8 OF 8 SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. l	BLOW COUNTS g	REMARKS h
		A 1			VSB-49-60 @ 1822		
	60						
		Bottom of hole 60'					
	61						
	62						

FORM MRK JUN 89 55-2

PROJECT

HOLE NO.

Appendix C

Cost Estimate Summary

Vault 4, Raco Army Airfield, Michigan

Alternative 2
Collection and Removal of TCE-Contaminated Sludge with Off-Site Disposal and In-Place Closure of Vault 4

COST ESTIMATE SUMMARY

Site: Vault 4 and Trichloroethylene Contaminated Sludge
Location: Raco Army Airfield
Phase: EE/CA
Base Year: 2018

Capital Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Indirect Capital Costs					
Planning Documents	1	LS	$ 47,911.00	$ 47,911.00	Includes EE/CA, Action Memo, Removal Action Work Plan, and UFP-QAPP
Field Summary Report	1	LS	$ 8,598.00	$ 8,598.00	
			SUBTOTAL	**$ 56,509.00**	
Direct Capital Costs					
Removal Action	1	LS	$ 58,842.89	$ 58,842.89	See Cost Worksheet
			SUBTOTAL	**$ 58,842.89**	
Other Project Costs					
Project Contingency	6%			$ 3,372.87	
			TOTAL CAPITAL COST	**$ 118,720.00**	

Annual Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
none				$ -	
			SUBTOTAL	$ -	
			TOTAL ANNUAL COST	**$ -**	

Periodic Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
				$ -	
			TOTAL PERIODIC COST	$ -	

TOTAL COST **$ 118,720.00**

Total Present Worth Cost: $0

Vault 4, Raco Army Airfield, Michigan

Alternative 2

Excavation of TCE Contaminated Sludge with Off-Site Disposal

COST WORKSHEET

Site: Vault 4 and Trichloroethylene Contaminated Sludge
Location: Raco Army Airfield
Phase: EE/CA
Base Year: 2018

Cost Analysis

Soil Excavation/Hauling/Disposal/Reporting (Capital Expense)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Excavate 165 cubic yards of TCE contaminated soil/sludge and concrete (non-haz)					
Rolloff Delivery	4	EA	$ 280.00	$ 1,120.00	
Rolloff Rental	4	WK	$ 184.80	$ 739.20	
Rolloff Liners	4	EA	$ 84.00	$ 336.00	
Sludge Removal (vac truck)	24	HR	$ 196.00	$ 4,704.00	
Excavation Mob/Demob	2	EA	$ 3,808.00	$ 7,616.00	
Excavation	2	DAY	$ 6,720.00	$ 13,440.00	
Site Restoration	1	LS	$ 6,160.00	$ 6,160.00	
			SUBTOTAL	**$ 34,115.20**	
Transport/Disposal of 165 tons of TCE contaminated soil/sludge and concrete (non-haz)					
Transportion/Disposal (Non-Haz	95	Tons	$ 85.70	$ 8,141.50	
			SUBTOTAL	**$ 8,141.50**	
Excavation and Oversight (Personnel)					
Project Management/Planning	23	Hour	$ 116.64	$ 2,682.72	
Regulatory Specialist	2	Hour	$ 111.51	$ 223.02	
Field Technician	80	Hour	$ 68.08	$ 5,446.40	
Technical/Specifications Writer	32	Hour	$ 94.88	$ 3,036.10	
Chemist	2	Hour	$ 118.27	$ 236.54	
Field Equipment	1	LS	$ 2,072.00	$ 2,072.00	
Lodging and Per Diem	5	DAY	$ 170.65	$ 853.25	
Lab Samples	1	LS	$ 358.40	$ 358.40	
Truck	7	DAY	$ 94.08	$ 658.56	
Mileage	1400	Miles	$ 0.73	$ 1,019.20	
			SUBTOTAL	**$ 16,586.19**	
TOTAL CAPITAL COST				**$ 58,842.89**	

Vault 4, Raco Army Airfield, Michigan

Alternative 3

Excavation of Vault 4 and TCE Contaminated Sludge with Off-Site Disposal

COST ESTIMATE SUMMARY

Site: Vault 4 and Trichloroethylene Contaminated Sludge
Location: Raco Army Airfield
Phase: EE/CA
Base Year: 2018

Capital Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
Indirect Capital Costs					
Planning Documents	1	LS	$ 47,911.00	$ 47,911.00	Includes EE/CA, Action Memo, Removal Action Work Plan, and UFP-QAPP
Field Summary Report	1	LS	$ 8,598.00	$ 8,598.00	
			SUBTOTAL	**$ 56,509.00**	
Direct Capital Costs					
Removal Action	1	LS	$ 85,862.69	$ 85,862.69	See Cost Worksheet
			SUBTOTAL	**$ 85,862.69**	
Other Project Costs					
Project Contingency	6%			$ 4,921.65	
			TOTAL CAPITAL COST	**$ 147,290.00**	

Annual Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
none				$ -	
			SUBTOTAL	$ -	
			TOTAL ANNUAL COST	**$ -**	

Periodic Costs

Description	QTY	UNIT	UNIT COST	TOTAL	NOTES
				$ -	
			TOTAL PERIODIC COST	$ -	

TOTAL COST **$ 147,290.00**

Total Present Worth Cost: $0

Vault 4, Raco Army Airfield, Michigan

Alternative 3

Excavation of Vault 4 and TCE Contaminated Sludge with Off-Site Disposal

COST WORKSHEET

Site: Vault 4 and Trichloroethylene Contaminated Sludge
Location: Raco Army Airfield
Phase: EE/CA
Base Year: 2018

Cost Analysis

Soil Excavation/Hauling/Disposal/Reporting (Capital Expense)

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES
Excavate 165 cubic yards of TCE contaminated soil/sludge and concrete (non-haz)					
Rolloff Delivery	6	EA	$ 280.00	$ 1,680.00	
Rolloff Rental	6	WK	$ 184.80	$ 1,108.80	
Rolloff Liners	6	EA	$ 84.00	$ 504.00	
Sludge Removal (vac truck)	24	HR	$ 196.00	$ 4,704.00	
Excavation Mob/Demob	2	EA	$ 3,808.00	$ 7,616.00	
Excavation	4	DAY	$ 6,720.00	$ 26,880.00	
Site Restoration	1	LS	$ 6,160.00	$ 6,160.00	
			SUBTOTAL	**$ 48,652.80**	
Transport/Disposal of 165 tons of TCE contaminated soil/sludge and concrete (non-haz)					
Transportion/Disposal (Non-Haz	165	Tons	$ 85.70	$ 14,140.50	
			SUBTOTAL	**$ 14,140.50**	
Excavation and Oversight (Personnel)					
Project Management/Planning	23	Hour	$ 116.64	$ 2,682.72	
Regulatory Specialist	2	Hour	$ 111.51	$ 223.02	
Field Technician	117	Hour	$ 68.08	$ 7,965.36	
Technical/Specifications Writer	32	Hour	$ 94.88	$ 3,036.10	
Chemist	2	Hour	$ 118.27	$ 236.54	
Field Equipment	1	LS	$ 2,632.00	$ 2,632.00	
Lodging and Per Diem	5	DAY	$ 170.65	$ 853.25	
Lab Samples	1	LS	$ 3,480.40	$ 3,480.40	
Truck	10	DAY	$ 94.08	$ 940.80	
Mileage	1400	Miles	$ 0.73	$ 1,019.20	
			SUBTOTAL	**$ 23,069.39**	
TOTAL CAPITAL COST				**$ 85,862.69**	