ARF-024186

Savannah River
NUCLEAR SOLUTIONS℠
FLUOR • NEWPORT NEWS NUCLEAR • HONEYWELL

Sampling and Analysis Plan for the A-Area Burning/Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A, -5A) Operable Unit to Evaluate the Effectiveness of the Soil Vapor Extraction System at Achieving Remedial Goals (U)

SEMS Number: 28

SRNS-RP-2022-01080

Revision 1

May 2023

DISCLAIMER

Printed in the United States of America

Prepared for
U.S. Department of Energy
and
Savannah River Site Nuclear Solutions, LLC
Aiken, South Carolina

TABLE OF CONTENTS

Section **Page**
LIST OF FIGURES iv
LIST OF TABLES iv
LIST OF ABBREVIATIONS AND ACRONYMS v
1.0 INTRODUCTION 1
1.1 ABRP/MCB/MBP OU Location 1
1.2 Statement of Broad Objective for the Sampling 1
2.0 SAMPLING UNIT BACKGROUND 2
2.1 Sampling Area Physical and Geographical Description 2
2.2 Operational History 2
2.2.1 ABRP Trench Subunit Operational History 2
2.2.2 MCB Subunit Operational History 3
2.3 Previous Investigations/Regulatory Actions 3
2.4 Summary of Existing Data Compared to Risk-Based Thresholds 4
3.0 PROJECT DATA QUALITY OBJECTIVES 4
3.1 ABRP/MCB/MBP OU Potential Contamination 5
3.1.1 State the Problem 5
3.1.2 Identify Goals of the Study 6
3.1.3 Identify Information Inputs 6
3.1.4 Define the Boundaries of the Study 7
3.1.5 Develop the Analytical Approach 7
3.1.6 Specify Performance or Acceptance Criteria 8
3.1.7 Develop the Plan for Obtaining the Data (Project Quality Objectives) 9
4.0 SAMPLING DESIGN AND RATIONALE 10
5.0 ANALYTICAL PLAN 11
5.1 Data Quality Levels for the ABRP/MCB/MBP OU 11
5.2 Field Analytical Sampling Quality Assurance/Quality Control 12
5.3 Sample Matrix Table 13
5.4 Sample Location Map 13
6.0 FIELD IMPLEMENTATION 13
6.1 List of Sampling/Collection Equipment 13
6.2 Investigation Derived Waste 14
7.0 REFERENCES 15

LIST OF FIGURES

Figure		Page
Figure 1.	Location of the ABRP/MCB/MBP OU	17
Figure 2.	ABRP/MCB/MBP OU Subunits at Savannah River Site	19
Figure 3.	ABRP Vadose Zone Well Configuration and Treatment Area	21
Figure 4.	MCB SVE Wells	23
Figure 5.	ABRP Soil-Gas Vapor Concentration Over Time Trend Diagram	24
Figure 6.	MCB Soil-Gas Vapor Concentration Over Time Trend Diagram	25
Figure 7.	ABRP Proposed Soil Boring Locations with 2021 Maximum TCE Cocnentrations (ppmv)	27
Figure 8.	MCB Proposed Soil Boring Locations with 2021 Maximum TCE and PCE Concentrations (ppmv)	28
Figure 9.	Hydrostratigraphic Column Diagram	29

LIST OF TABLES

Table		Page
Table 1.	Summary of Remedial Goals for ABRP	30
Table 2.	Summary of Remedial Goals for MCB	30
Table 3.	Data Quality Objectives Worksheet for Soil Media	30
Table 4.	Sampling Matrix Table	31
Table 5.	Laboratory Analytical Specifications for Target Compound List Analytes for Soil Media	32
Table 6.	Preservatives, Holding Times, and Sample Containers	32
Table 7.	Field Quality Control/Quality Assurance Sampling Requirements	32

LIST OF ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
ABRP	A-Area Burning/Rubble Pits
BRA	Baseline Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CM	contaminant migration
COC	constituent of concern
CRDL	Contract Required Detection Limit
D	Definitive Level
DQD	Decision Quality Data
DQO	Data Quality Objective
ft	feet
IC	Institutional Control
IDW	Investigation Derived Waste
km	kilometer
m	meter
MAML	M-Area and Metallurgical Laboratory
MBP	Metals Burning Pit
MCB	Miscellaneous Chemical Basin
MCL	maximum contaminant level
μg/kg	microgram per kilogram
mi	mile
mL	milliliter
OU	Operable Unit
PCE	Tetrachloroethylene
PER	Performance Evaluation R
PID	photoionization detector
ppmv	parts per million by volume
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Program Plan
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RG	Remedial Goal
ROD	Record of Decision
SAP	Sampling and Analysis Plan
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SVE	Soil Vapor Extraction
TCE	Trichloroethylene
USEPA	United States Environmental Protection Agency
VOA	volatile organic analysis
VOC	volatile organic compound

LIST OF ABBREVIATIONS AND ACRONYMS

WSRC	Westinghouse Savannah River Company, LLC
ZOI	zone of influence

1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared in accordance with the United States Environmental Protection Agency (USEPA) *Uniform Federal Policy for Quality Assurance Project Plans* (USEPA et al 2005) and the *Area Completion Projects Programmatic Quality Assurance Project Plan for Environmental Data Collection and Management* (Savannah River Nuclear Solutions, LLC [SRNS] 2012). Project or task specific information for the consolidated A-Area Burning/Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) (ABRP) and Miscellaneous Chemical Basin (MCB)/Metals Burning Pit (MBP) (731-4A, 5A) Operable Unit (OU) is documented in this SAP and refers to the program level Quality Assurance Program Plan (QAPP) (SRNS 2012) for the program level quality objectives, standard operating procedures, and quality assurance (QA)/quality control (QC) procedures.

1.1 ABRP/MCB/MBP OU Location

The ABRP/MCB/MBP OU is located approximately 2.4-kilometers (km) (1.5 miles [mi]) south of M Area and 4.8 km (3 mi) east of the Savannah River Site (SRS) boundary, in the Upper Three Runs watershed (Figure 1). The ABRP/MCB/MBP OU comprises several subunits (Figure 2). This SAP specifically addresses the remedial actions (RAs) conducted at the ABRP Trench (vadose zone soil) Subunit and the 731-4A MCB Vadose Zone Subunit and are summarized in Section 2.0.

1.2 Statement of Broad Objective for the Sampling

The primary objective of this SAP is to strategically collect samples that assist in evaluating the effectiveness of the current soil vapor extraction (SVE) remediation method in reaching the ABRP/MCB/MBP OU remedial goals (RGs) (i.e., cleanup levels), which are intended to prevent tetrachloroethylene (PCE) and trichloroethylene (TCE) in the vadose zone soil from leaching to groundwater above maximum contaminant levels (MCLs).

2.0 SAMPLING UNIT BACKGROUND

2.1 Sampling Area Physical and Geographical Description

ABRP/MCB/MBP is listed in Appendix C of the Federal Facility Agreement as a Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) OU.

The ABRP/MCB/MBP OU is situated on the eastern side of a topographic divide which separates Tims Branch and its tributaries from swampland and low-lying areas to the west. This ridge drains east to Tims Branch and west to the Savannah River floodplain. Its relief is characterized by flat areas and a few low rolling hills. The ABRP/MCB/MBP OU is surrounded by gravel access roads and flat, grassy, wooded terrain.

Surficial soils at the ABRP/MCB/MBP OU consist of fine-grained sediments (i.e., silty sandy clay) to a depth of ~9 meters (m) (30 feet [ft]), known as the Upland Unit. The Upland Unit has limited contaminant mobility to a significant degree by having a high porosity (i.e., void space between sediment grains) and low permeability (i.e., connectivity between sediment grains). The high porosity provides a space for temporary storage of the volatile organic compounds (VOCs), while the low permeability restricts the VOCs from migrating downward. VOC migration through the Upland Unit is primarily through diffusion. Below the Upland Unit, more permeable sediments extend downward to the water table at ~41-m (135-ft) below ground surface (bgs). The more permeable sediments consist of a series of silty sand beds separated by laterally discontinuous clay beds. Figure 9 represents the hydrostratigraphic column from ground surface to the water table. Details regarding the nature and extent of contaminants are included in the ABRP RCRA Facility Investigation/Remedial Investigation Report (RFI/RI) (Westinghouse Savannah River Company LLC [WSRC] 1997) and MCB RFI/RI (WSRC 1992) documents.

2.2 Operational History

2.2.1 ABRP Trench Subunit Operational History

The Trench Subunit extends north-south and was mostly buried beneath 6.1 m (20 ft) of compacted ash along the eastern portion of the A-Area Ash Pile. The Trench was filled with debris and covered with soil prior to construction of the A-Area Ash Pile. The Trench measures approximately 4.6 x 91.4 m (15 x 300 ft). The Trench is between 2.4 and 4.6 m (8 and 15 ft) deep with approximately 5 to 10% of its length exposed to the south of the A-Area Ash Pile.

2.2.2 MCB Subunit Operational History

The MCB is an old borrow pit that received liquid chemical waste from about 1956 to 1974. No records of the types or amounts of material disposed of are available. It is believed that drums were emptied at the MCB and then discarded at the MBP. In 1974, the MCB, which was approximately 6 x 6 m (20 x 20 ft) and approximately 0.3 m (1 ft) deep, was graded and allowed to revegetate naturally.

2.3 Previous Investigations/Regulatory Actions

The overall strategy for addressing the ABRP/MCB/MBP OU was to: 1) characterize the waste unit, delineating nature and extent of contamination and identifying the media of concern; 2) perform a baseline risk assessment (BRA) to evaluate the media of concern, constituents of concern (COCs), and exposure pathways and characterize potential risks; and 3) select and perform a final action to remediate, as needed, the identified media of concern.

Detailed facility descriptions are given in the RFI/RI Report with BRA for the ABRP (WRSC 1997) and the RFI/RI Report with BRA for the MCB/MBP (WSRC 1992). TCE was determined to be the contaminant migration (CM) COC for ABRP. PCE and TCE were determined to be CM COCs for MCB. A structured analysis of remedial alternatives appropriate for these COCs was conducted, and alternatives were developed that could meet the remedial action objective of preventing migration of TCE and PCE contamination in soil to groundwater at a concentration above MCLs.

A Record of Decision (ROD) detailing the selected remedial alternative as Phased SVE and Institutional Controls (ICs) at the ABRP/MCB/MBP OU was issued in February 2007 (WSRC 2007a). This alternative was selected because it effectively removes VOCs from the vadose zone and protects groundwater by depleting the source. No chemicals are used. System air emissions do not require treatment and are vented to the atmosphere. ICs are used to limit access to the area.

SRS documents land use control inspections in the Five-Year Remedy Review Reports. Operations at the ABRP/MCB/MBP OU for the foreseeable future are expected to be remediation-oriented (passive SVE) with site level access controls. Additionally, a Performance Evaluation Report (PER) is written annually for ABRP/MCB/MBP SVE systems (SRNS 2022b).

The groundwater contamination in M Area is being addressed under the RCRA corrective action program for the A/M Area as documented in the SRS RCRA Permit and is therefore not a part of the ABRP/MCB/MBP OU. Any groundwater contamination resulting from the ABRP/MCB/MBP OU is addressed by the requirements of the M-Area and Metallurgical Laboratory Hazardous Waste Management Facilities groundwater monitoring and corrective action agreements.

2.4 Summary of Existing Data Compared to Risk-Based Thresholds

The summary of the contaminant migration RGs for the ABRP/MCB/MBP OU is provided in Table 1 for the ABRP Trench Subunit (TCE RG = 610 microgram per kilogram [ug/kg]) and Table 2 for the MCB Vadose Zone Subunit (TCE and PCE RG = 344 ug/kg). These final cleanup levels are consistent with an industrial land use scenario. The soil RGs were developed based on soil sampling conducted in the mid- to late-1990's. Since then, SVE has removed mass from the source zones at ABRP/MCB/MBP OU. Soil vapor concentrations collected from the SVE wells have declined with time. In 2021, the maximum soil vapor TCE concentration measured within the 610 ug/kg isoconcentration contour at the ABRP Trench subunit was 0.84 ppmv at SVE well ASH-06 (Figure 7). At the MCB Vadose Zone subunit, the maximum soil vapor concentrations measured within the 344 ug/kg isoconcentration contour in 2021 from MCB SVE wells was 0.81 ppmv TCE (MCSV-17) and 1.81 ppmv PCE (MCSV-07) (Figure 8). Soil data obtained as a result of this SAP will be compared to the RG values.

3.0 PROJECT DATA QUALITY OBJECTIVES

The Data Quality Objectives (DQO) process is a series of logical steps that guides managers or staff to a plan for the resource-effective acquisition of environmental data. It is both flexible and iterative, and applies to both decision-making (e.g., compliance/non-compliance with a standard) and estimation (e.g., ascertaining the mean concentration level of a contaminant). The DQO process is used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study. Use of the DQO process leads to efficient and effective expenditure of resources; consensus on the type and quantity of data needed to meet the project goal; and the full documentation of actions taken during the development of the project. The DQO process is a series of seven planning steps based on the scientific method (Sections 3.1.1 to 3.1.7 and Table 3) and is detailed in USEPA Guidance (USEPA 2006).

3.1 ABRP/MCB/MBP OU Potential Contamination

3.1.1 State the Problem

The primary contaminant release mechanisms at the ABRP/MCB/MBP OU were the deposition of contaminants on the soil during waste disposal and infiltration/percolation of the waste constituents in the pits and basin to subsurface soil. TCE and PCE are the CM COCs and have contributed to groundwater contamination at the OU. The vadose zone consists of fine-grained sediments (i.e., silty sandy clay) to a depth of ~9 m (30 ft), known as the Upland Unit and more permeable sediments downward to the water table at ~41-m (135-ft) bgs. TCE and PCE present in the vadose zone has been the target of SVE remediation since 1996 at MCB and 2001 at ABRP.

Analysis of 2021 soil gas data indicates PCE and TCE vapor concentrations demonstrated generally decreasing values. Historical TCE concentrations have decreased significantly at ABRP since 2005 (87 parts per million by volume [ppmv] TCE maximum) to 0.8 ppmv TCE maximum in 2021 (Figure 5). Historical PCE and TCE concentrations have decreased significantly at MCB since 2004 (37 ppmv PCE maximum and 3 ppmv TCE maximum) to 2 ppmv PCE maximum and 1 ppmv TCE maximum in 2021 (Figure 6). Although the historical data demonstrates generally decreasing values, the PCE and TCE concentrations slightly increased from 2020 to 2021 (Figure 6). VOC vapor concentrations indicate a localized, declining PCE/TCE source area within the zone of capture of the SVE units. The characterization results for this SAP will be used to verify the efficiency of the current SVE system and as a baseline for the project as it relates to meeting RG values agreed upon in the ROD.

3.1.2 Identify Goals of the Study

For the ABRP/MCB/MBP OU, the CM remedial action objective (RAO) is that soil concentrations of TCE and PCE will not impact groundwater above MCLs. Contaminant migration modeling was used to establish TCE soil concentrations that would not adversely impact the underlying groundwater at ABRP (WSRC 2005). Contaminant migration modeling was used to establish PCE and TCE soil concentrations that would not adversely impact the underlying groundwater at MCB (WSRC 2005). The RGs are listed in Tables 1 and 2. The characterization results for this SAP will be used to verify the efficiency of the current SVE system and as a baseline for the project as it relates to meeting RG values agreed upon in the ROD. The goals of this sampling effort are to measure current TCE concentrations at ABRP and current PCE and TCE concentrations at MCB in soil within the remedial zone of influence (ZOI) to determine if the current SVE systems can be discontinued or optimized to achieve RGs more efficiently.

The 2024 sampling event will strategically collect vadose zone soil samples at the ABRP/MCB/MBP OU. Since the sampling effort will be conducted within the ZOI of the SVE systems, there will be a strong correlation with the individual borings showing how effective the SVE systems have performed over the last decade. If warranted, the sampling results will be utilized in an updated contaminant migration analysis to evaluate the effectiveness of the current SVE remediation in reaching the RGs for TCE and PCE. The depth of the sampling will also demonstrate contaminant geometry within the target area and SVE efficiency at depth.

The soil samples will be collected in 2024, and the data will be reported in the 2025 PER and submitted concurrently with the Contaminant Migration Modeling Report, if one is warranted.

3.1.3 Identify Information Inputs

3.1.3.1 <u>Soil Samples</u>

Twelve soil borings will be advanced at ABRP (ABRP-001-SB to ABRP-012-SB), and eleven soil borings will be advanced at MCB (MCB-001-SB to MCB-011-SB). All soil borings will be advanced to a target depth of 36.58 m (120 ft). Samples collected at ABRP will be analyzed for TCE, and samples collected at MCB will be analyzed for PCE and TCE (Table 5).

3.1.3.2 Sampling and Analysis Procedures

SRS drilling and soil sampling will be performed through accepted procedures found in the SRS 3Q1 Manual, Section 9006, *Soil Boring Investigations* (SRNS 2021). Soil samples for TCE and PCE analysis will be collected using EPA5035 collection method. These procedures ensure representative sampling techniques are always followed in the field.

The subcontract laboratory shall be certified for EPA8260B method by the South Carolina Department of Health and Environmental Control. The analytical method and laboratory have been audited and approved by U.S. Department of Energy Consolidated Audit Program. The analyses shall be performed according to Quality Systems for Analytical Services requirements.

3.1.4 Define the Boundaries of the Study

Sampling will be conducted within the boundaries of the ABRP/MCB/MBP OU. Sampling will occur throughout the vadose zone downward to the water table. The proposed soil borings at ABRP and MCB are located proximal to the distribution of the existing SVE wells, which were principally placed in the zone of contamination above RGs. The locations of the existing SVE wells at ABRP and MCB in relation to the zones of contamination above RGs are provided respectively in Figures 3 and 4. There will not be any temporal boundaries (i.e., the period of time the study should represent with consideration of time-related conditions, such as high humidity and/or elevated temperatures) associated with sample collection, as a single round of soil samples is proposed. Underground interferences and existing above ground infrastructure are potential practical constraints in the sampling area. To eliminate any practical constraints, the sampling locations will be relocated to a safe distance away.

3.1.5 Develop the Analytical Approach

Soil borings will be advanced to a depth of 36.58 m (120 ft) bgs at twenty-three locations (Table 4). The number of soil borings were selected based on the degree of contamination known at the locations. Twelve soil borings will be advanced at ABRP, and eleven soil borings will be advanced at MCB. Soil samples will be taken, at a minimum of every 1.5 m (5 ft), with optional samples taken every 0.61 m (2ft) starting at 4.57 m (15 ft) bgs. Discrete soil samples will be collected in horizons of high VOC concentrations as identified by a photoionization detector (PID) that will be run continuously as core is retrieved and where significant changes in lithology (i.e., sharp contacts between high and low permeability sediment) are observed. Samples collected at ABRP will be analyzed for TCE, and samples collected at MCB will be analyzed for PCE and TCE (Table 5).

If greater than 95% of the TCE and PCE results are less than the RGs, then operation of the SVE systems can be discontinued. If 50% or more of the TCE and PCE results are greater than the RGs, then passive SVE operations will continue. If between 50-95% of the TCE and PCE results are less than the RGs, then an evaluation of the data distribution and concentrations will be conducted that may support a refined fate and transport model, shutdown of some of the wells, or conversion of MicroBlower™ SVE wells to BaroBall™ SVE wells.

3.1.6 Specify Performance or Acceptance Criteria

According to USEPA guidance (USEPA 2006), "The USEPA has developed the DQO Process as the Agency's recommended planning process when environmental data are used to select between two or more alternatives or to derive an estimate of contamination. The DQO process is a seven-step method designed to ensure that the appropriate type, quantity, and quality of environmental data are collected for the intended application." SW-846 methods are analytical procedures for sample analyses and are presented in Section 5, Analytical Plan. Table 3 presents the DQO worksheet developed for ABRP/MCB soil media and specifies the quantity, type, and quality of data as well as ensuring representative data is collected for each sampling population.

Total study error is the additive impact of two main sources of error: 1) sampling error and 2) measurement error, with sampling error being responsible for the vast majority of the total error. "As much as 90% or more of the uncertainty in environmental data sets is due to sampling variability as a direct consequence of the heterogeneity of the environmental matrices" (Crumbling et al 2001). The method best suited to reduce sampling error is to gather representative samples.

It is incorrect to assume that randomly collected, non-representative samples, plus perfect analytical chemistry will always lead risk managers to correct risk management decisions. To avoid incorrect risk management decisions, it is more important to develop Decision Quality Data

(DQD). DQD is defined as "Data of known quality that can logically be demonstrated to be effective for making the specified decision because both the sampling and analytical uncertainties are managed to the degree necessary to meet clearly defined and stated data needs" (Crumbling et al 2001). Therefore, it is more important for the risk managers to use DQD, emphasizing representative sampling with a specified percentage of definitive data, to make a correct decision and should not be confused by emphasizing analytical data quality, which does not necessarily equate to a correct risk management decision.

Because SRS possesses significant process and historical knowledge and has preliminary data results for the ABRP/MCB/MBP OU, this sampling plan will largely control sampling error (the cause of greatest total error) and set tolerable limits on decision errors by gathering data by judgmental, judgmental-stratified, and systematic sampling designs based on process knowledge, existing data, historical information/data, survey data, and institutional knowledge to generate DQD. This is the method SRS will use to control decision errors, since sample collection will be focused in areas of known contamination rather than using a sampling design intended to randomly search for contamination. Judgmental sampling provides a very conservative and certain method for collecting data with a high likelihood for detecting worst-case contaminant concentrations while reducing total study error.

The DQOs for the ABRP/MCB/MBP OU represent the type and level of analytical quality needed for characterization at this unit and can be found in Sections 4 and 5 of this SAP.

3.1.7 Develop the Plan for Obtaining the Data (Project Quality Objectives)

Table 3 (DQO Worksheet) summarizes the DQOs for this project. The Project Quality Objectives for this additional characterization SAP are:

1. 90% of planned samples are collected and their data are useable for completeness data quality indicator
2. 5% of the samples will be duplicate and split samples for the comparability data quality indicator.
3. No target compound >= sample-specific estimated quantitation limit for equipment blank, field blanks, method blanks, or instrument blanks for accuracy data quality indicator

4. Laboratory data will be used to support a determination as to whether further remedial action is warranted.
5. All (i.e., 100%) samples will follow preservative guidelines as listed in Table 6.
6. Laboratory data will meet the analytical and contract-required detection limits (CRDLs) listed in Table 5.

4.0 SAMPLING DESIGN AND RATIONALE

Implementation of the SAP to obtain DQD for the ABRP/MCB/MBP OU is documented in the remaining sections of this SAP. The following section describes how the plan is implemented to collect the physical data to meet the criteria developed during the DQO process.

The sampling scheme is designed to obtain current VOC concentrations to compare those concentrations to the RGs established for ABRP and MCB.

Soil data collected during 1996 and 2004 were used to developed the RG of 610 µg/kg for TCE (WSRC 2007b) (Figure 3). Proposed soil boring locations were placed considering the 610 µg/kg isoconcentration contour (Figure 7) and using recent 2021 TCE vapor concentrations (ppmv) measured at ABRP SVE wells. The highest TCE vapor concentrations in 2021 were observed at AHT-06, AHT007B, AHT008A, AHT008B, and ASH-06, which are all in close proximity to the ABRP Trench subunit and within the 610 µg/kg isoconcentration contour. Six of the 12 soil borings were placed near these SVE wells to verify if residual mass is present near the TCE source area. The 2021 TCE vapor concentrations are shown in red numbers on Figure 7. Samples will be collected every 0.61-1.5 m (2-5 ft) starting at 4.57 m (15 ft) bgs to a total depth of 36.58-m (120-ft) (Table 4). Coring will begin at 1.83 m (6 ft) bgs due to hand augering requirements to identify potential interferences.

The treatment area for the MCB Vadose Zone Subunit was established by the Interim ROD (WSRC 1999) based on the soil RG of 344 µg/kg for PCE and TCE (Figure 4). The area was identified by extensive characterization and sampling history at the MCB Subunit since 1996. Proposed soil borings were located around the 344 µg/kg PCE and TCE concentration contour, near the two MicroBlowers™ (MCSV-07 and MCSV-17) that had the highest concentrations in

2021, and near SVE wells that had detections of PCE and TCE in 2021 (Figure 8). PCE and TCE concentrations (ppmv) are shown in green and red numbers respectively on Figure 8. No soil borings were located within the 344 µg/kg isoconcentration based on the history of low vapor concentrations at SVE wells MCVS-13 and MCSV-04. Samples will be collected every 0.61-1.5 m (2-5 ft) starting at 4.57 m (15 ft) bgs to a total depth of 36.58 m (120 ft) (Table 4). Coring will not begin until 1.83 m (6 ft) bgs due to hand augering requirements to identify potential interferences.

Depth to groundwater in the area is estimated to average 41.1 m (135 ft) bgs with groundwater flow towards the southwest. Soil sampling will stop above the water table since the deep vadose zone is outside of the remediation ZOI targeted by the SVE systems. Residual VOC mass is anticipated to be highest in the shallow vadose zone soils, associated with the upland unit, and decline with depth at both ABRP and MCB units.

5.0 ANALYTICAL PLAN

This section describes the data quality levels for each type of data being collected. All data collected under this SAP will follow the *Area Completion Projects Quality Assurance Project Plan for Environmental Data Collection* and *Management (QAPP)* (SRNS 2012). The data quality level is determined by the intended use of the data.

5.1 Data Quality Levels for the ABRP/MCB/MBP OU

Soil characterization samples will be 100% Definitive level (D) data. 100% D data is verified data which has achieved the USEPA's Screening level Validation category (USEPA 1993) and meet the following selected aspects of USEPA Functional Guideline criteria: Quantitation Limits, Surrogate or Tracer Recoveries, Blanks (Method/Lab/Prep, Trip, Field, Equipment/Rinsate), Laboratory Control Samples Recoveries, Matrix Spike Recoveries/ Duplicates, Lab Replicates, Field Replicates, Cooler Temps, Chemical Preservation, Holding Times. Quantitation limits are specified in Table 5. Preservative, holding time, and container requirements for D data are listed in Table 6. Field Quality Control/Quality Assurance sampling requirements are listed in Table 7. The remaining aspects of EPA National Functional Guidelines criteria can be found in the *Area*

Completion Projects Programmatic Quality Assurance Project Plan for the Environmental Data Collection and Management (SRNS 2012).

5.2 Field Analytical Sampling Quality Assurance/Quality Control

Field QA/QC will be maintained using QA/QC samples and methods as described below and in Table 7 of this SAP.

1. Field Duplicate (co-located) Samples: Two or more independent samples collected from side-by-side locations at the same point in time and space to be considered identical. These separate samples are intended to represent the same population and are carried through all steps of the sampling and analytical procedures in an identical manner. These samples are used to assess precision of the total method, including sampling, analysis, and site heterogeneity. Field duplicate samples are planned at a combined minimum rate of 5% according to *Obtaining and Managing Environmental Data for Environmental Compliance & Area Completion Projects (U)* (SRNS 2022a), and analyzed for the same parameters as the associated samples.

2. Equipment Blank: A sample of water free of measurable contaminants poured over or through decontaminated field sampling equipment that is considered ready to collect or process an additional sample. The purpose of this blank is to assess the adequacy of the decontamination process. Also called rinse blank or rinsate blank. Equipment blanks are typically planned at a rate of 1 blank per 40 samples if needed. Equipment blanks will not be needed for this sampling project.

3. Field Blank: A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport; also, a clean sample exposed to sampling conditions, transported to the laboratory, and treated as an environmental sample. Field blanks are optional and may be collected when contamination from external environmental sources is anticipated by the project team. Typically, field blanks, when used, are planned at a rate of 1 blank per 40 samples.

4. Trip Blank: A clean sample of water free of measurable contaminants that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures. Trip blanks are analyzed to assess whether contamination was

introduced during sample shipment (typically analyzed for VOCs only). A blank consists of distilled-deionized water provided by the laboratory to be placed in every cooler with VOC samples typically at the rate of 1 trip blank per cooler.

5. Split Samples: Two or more representative portions from a sample in the field, analyzed by at least two different laboratories and/or methods. Prior to splitting, a sample is mixed (except volatiles, oil and grease, or when otherwise determined) to minimize sample heterogeneity. These are QC samples used to assess precision, variability, and data comparability between laboratories. Split samples are planned at a combined minimum rate of 5% or typically 1 per 20 samples and analyzed for the same parameters as the associated samples.

5.3 Sample Matrix Table

Table 4 is a Sampling Matrix table that includes all the detailed information for all samples planned to be collected. The exact number of samples may change based on field conditions.

5.4 Sample Location Map

Figure 7 and Figure 8 illustrate the proposed locations of samples to be collected.

6.0 FIELD IMPLEMENTATION

6.1 List of Sampling/Collection Equipment

This section provides the type of sampling/collection equipment needed to execute the sampling. All samples will be taken with the appropriate/ approved equipment as noted within the QAPP and sampling protocol procedures referenced within the SAP.

Sampling/collection equipment include the following:

- Rotosonic soil core in plastic bags
- Disposable plastic soil plug syringes
- Scale
- Sample bottles with preservatives
- Coolers
- PID

6.2 Investigation Derived Waste

Investigation Derived Waste (IDW) will be managed according to the site-specific IDW management plan developed for the project.

7.0 REFERENCES

Crumbling, Deana M., Cheryl Groenjes, Barry Lesnik, Kira Lynch, Johnnette Shockley, Jeff Van Ee, Robert Howe, Larry Keith, and Jerry McKenna, 2001. *Managing Uncertainty in Environmental Decisions*, Environmental Science & Technology, American Chemical Society, October 1, 2001, pages 405A-409A

SRNS, 2012. *Area Completion Projects Programmatic Quality Assurance Project Plan for Environmental Data Collection and Management*, ERD-AG-2005-00001, Revision 5, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2021. *Environmental Requirements and Program Documents: Soil Boring Investigations*, SRS Manual 3Q1, Procedure 9006, Revision 5, November, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2022a. *EC&ACP Geochemical Monitoring Procedures*: *Obtaining and Managing Environmental Data for Environmental Compliance & Area Completion Projects (U),* Manual C3, Volume X, ER-SOP-043, Revision 5, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2022b. *Performance Evaluation Report for the A-Area Burning Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin/Metals burning Pit (731-4A, -5A) Operable Unit*, *January through December 2021 (U)*, SRNS-RP-2022-00178, Revision 0, Savannah River Nuclear Solutions, Savannah River Site, Aiken, SC

USEPA, 1993. *Data Quality Objective Process for Superfund Interim Final Guidance*, EPA540-R-93-071, US Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC

USEPA, US Department of Defense, and US Department of Energy, 2005. *Uniform Federal Policy for Quality Assurance Project Plans*, EPA-505-B-04-900A, Version 1, US Environmental Protection Agency, Intergovernmental Data Quality Task Force

USEPA, 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001, US Environmental Protection Agency, Office of Environmental Information, Washington, DC

WSRC, 1992. *RCRA Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment for the for the Miscellaneous Chemical Basin/Metals Burning Pit* (U), WSRC-RP-92-483, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 1997. *RCRA Facility Investigation/Remedial Investigation Report with Baseline Risk Assessment for the for the A-Area Burning/Rubble Pits and Rubble Pit* (U), WSRC-RP-96-168, Revision 1.2, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 1999. *Interim Record of Decision Remedial Alternative Selection for the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A/5A)*, WSRC-RP-98-4031, Revision 1.1, Westinghouse Savannah River Company, Savannah River Site, Aiken SC

WSRC, 2005. *Corrective Measures Study/Feasibility Study Report for A-Area Burning/Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) and Miscellaneous Chemical Basin/Metals Burning Pit (731-4A/5A) Operable Unit (U)*, WSRC-RP-2003-4116, Revision 1, Westinghouse Savannah River Company, Savannah River Site, Aiken, SC

WSRC, 2007a. *Record of Decision Remedial Alternative Selection for the A-Area Burning/Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin/Metals Burning Pit (731-4A, -5A) Operable Unit (U),* WSRC-RP-2005-4095, Revision 1.1, Washington Savannah River Company, LLC., Savannah River Site, Aiken, SC

WSRC, 2007b. *Corrective Measures Implementation/Remedial Action Implementation Plan (CMI/RAIP) for the A-Area Burning/Rubble Pits (731-A, -1A) and Rubble Pit (731-2A) and the Miscellaneous Chemical Basin / Metals Burning Pit (731-4A, -5A) Operable Unit (U)*, WSRC-RP-2006-4071, Revision 1, Washington Savannah River Company, Savannah River Site, Aiken, SC

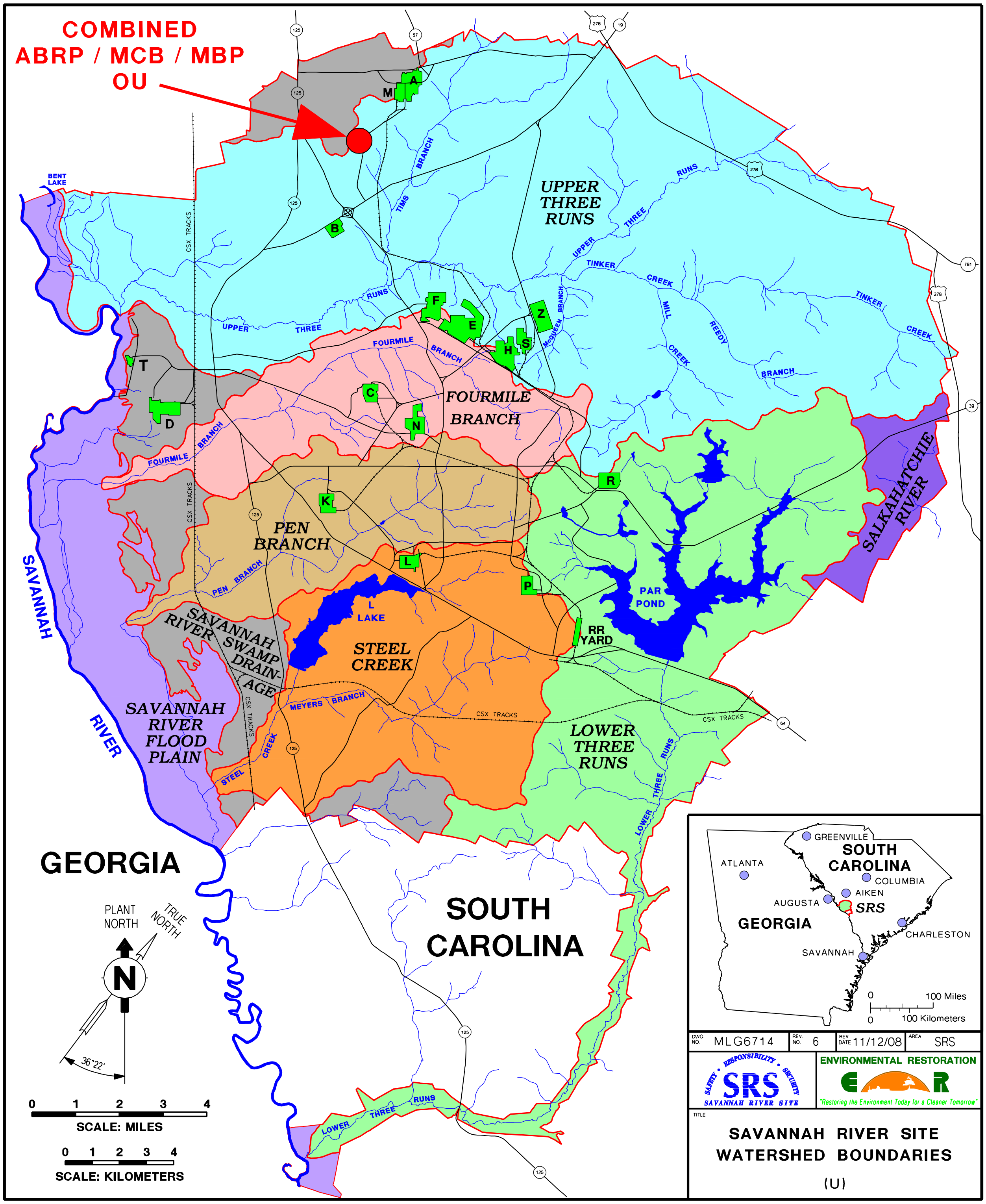

Figure 1. Location of the ABRP/MCB/MBP OU

This page intentionally let blank.

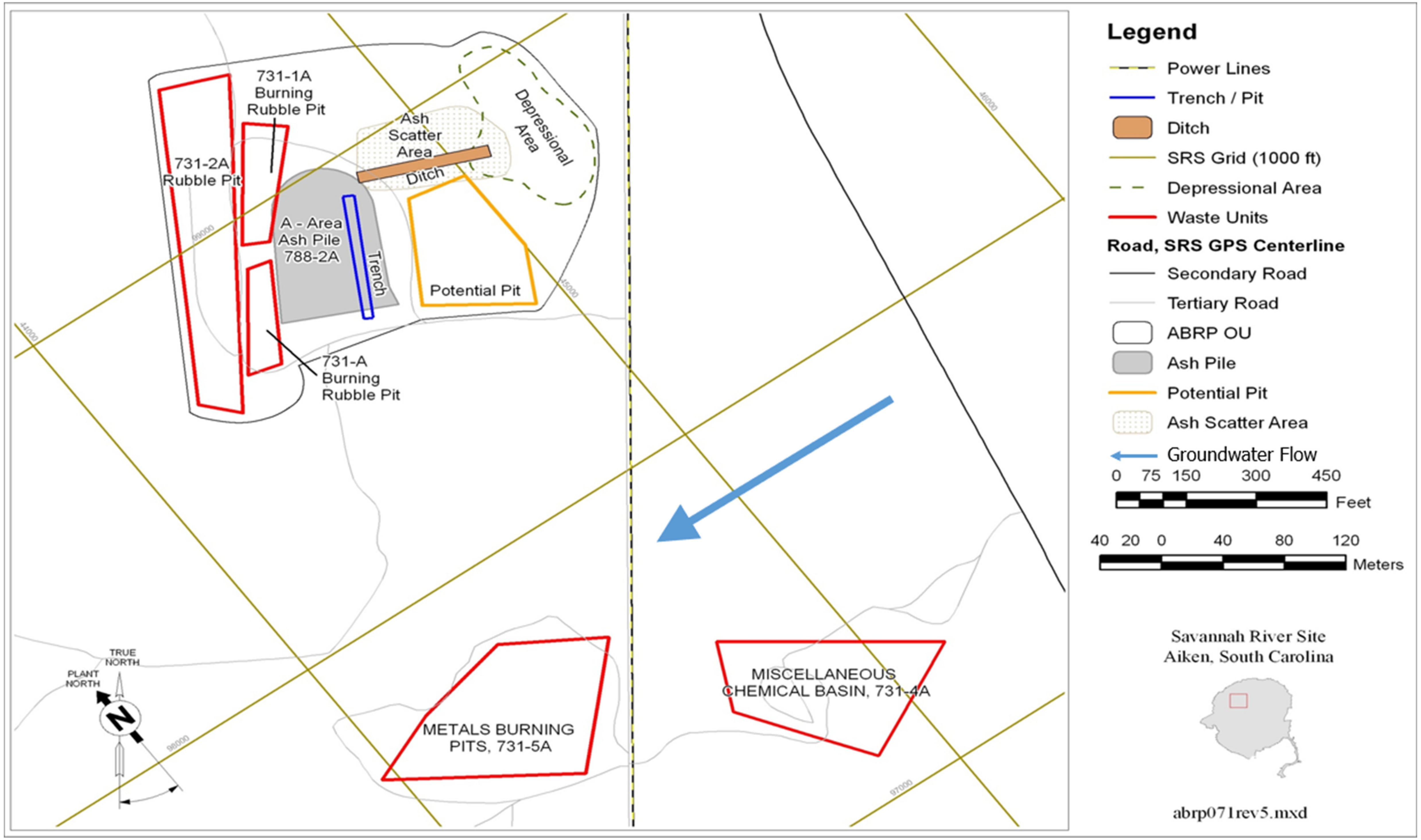

Figure 2. **ABRP/MCB/MBP OU Subunits at Savannah River Site**

This page intentionally left blank.

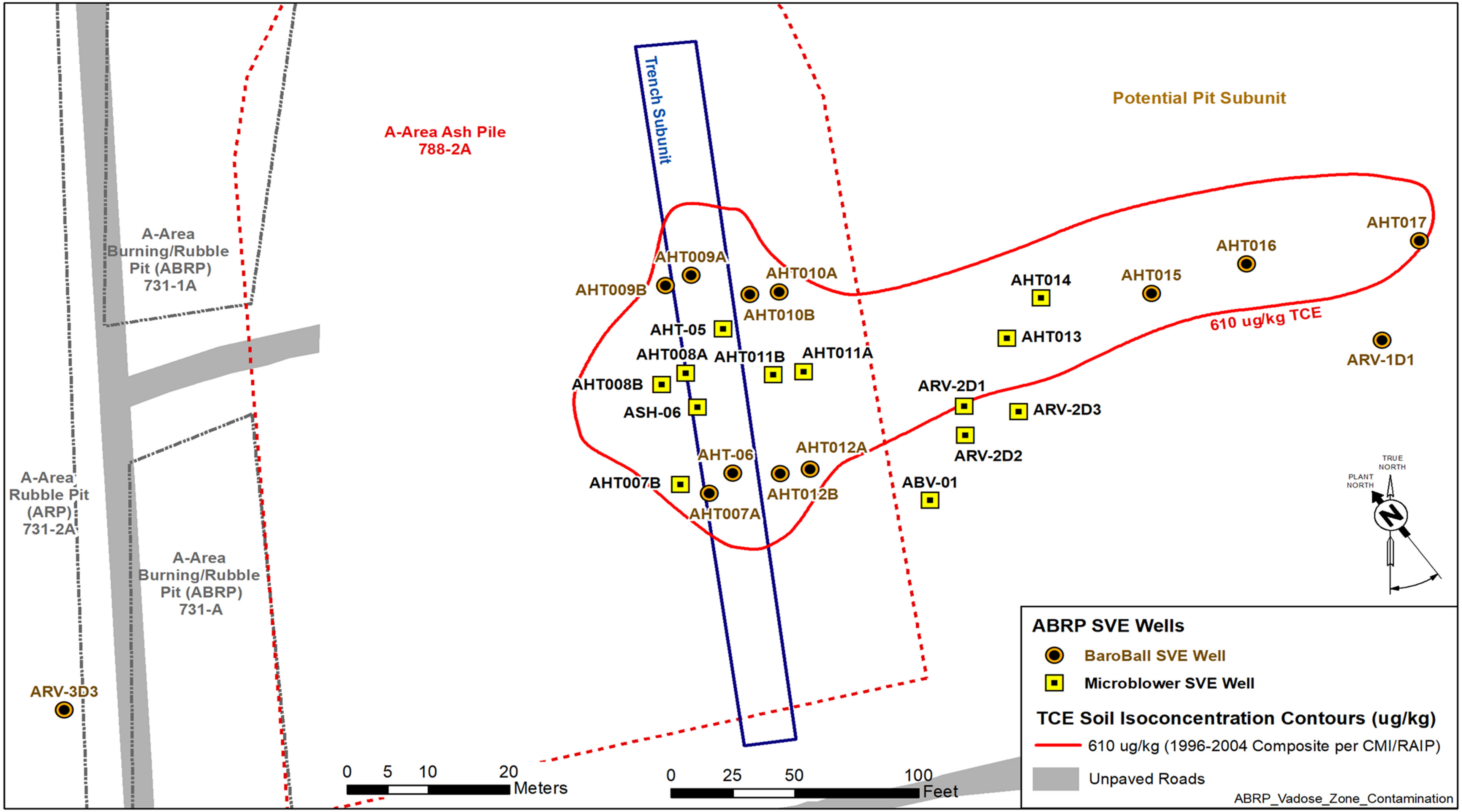

Figure 3. ABRP Vadose Zone Well Configuration and Treatment Area

This page intentionally left blank.

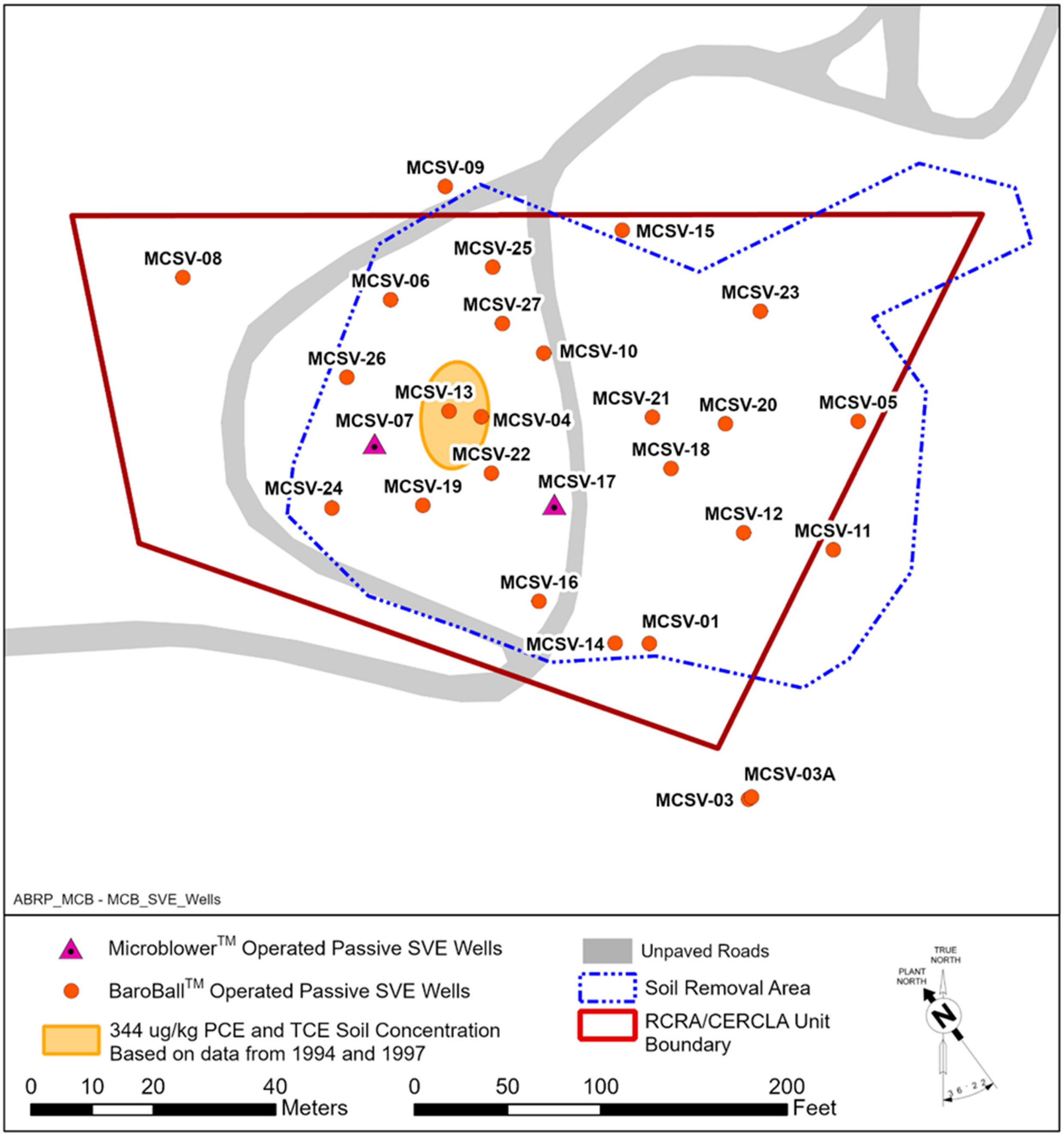

Figure 4. MCB SVE Wells

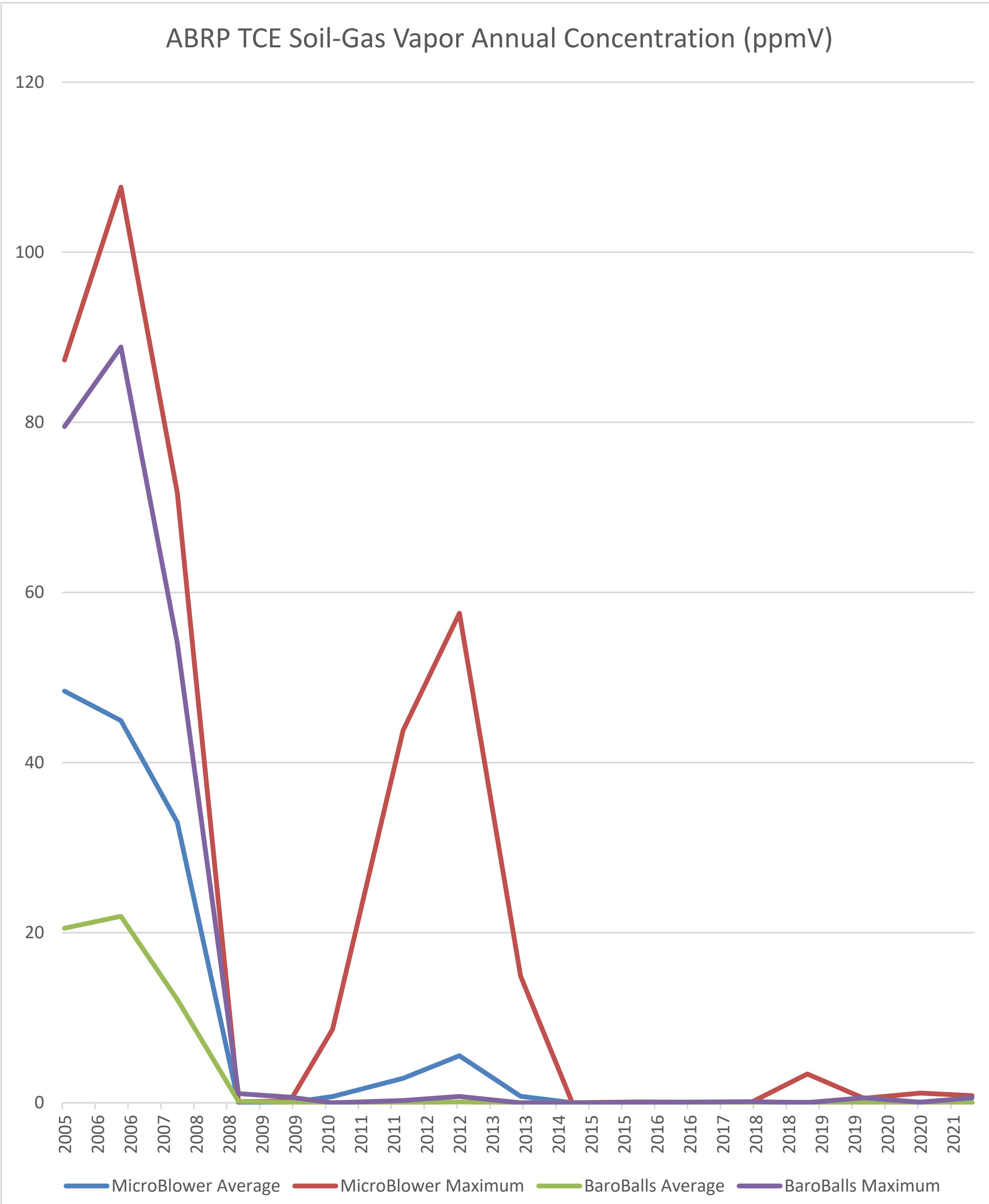

Figure 5. **ABRP Soil-Gas Vapor Concentration Over Time Trend Diagram**

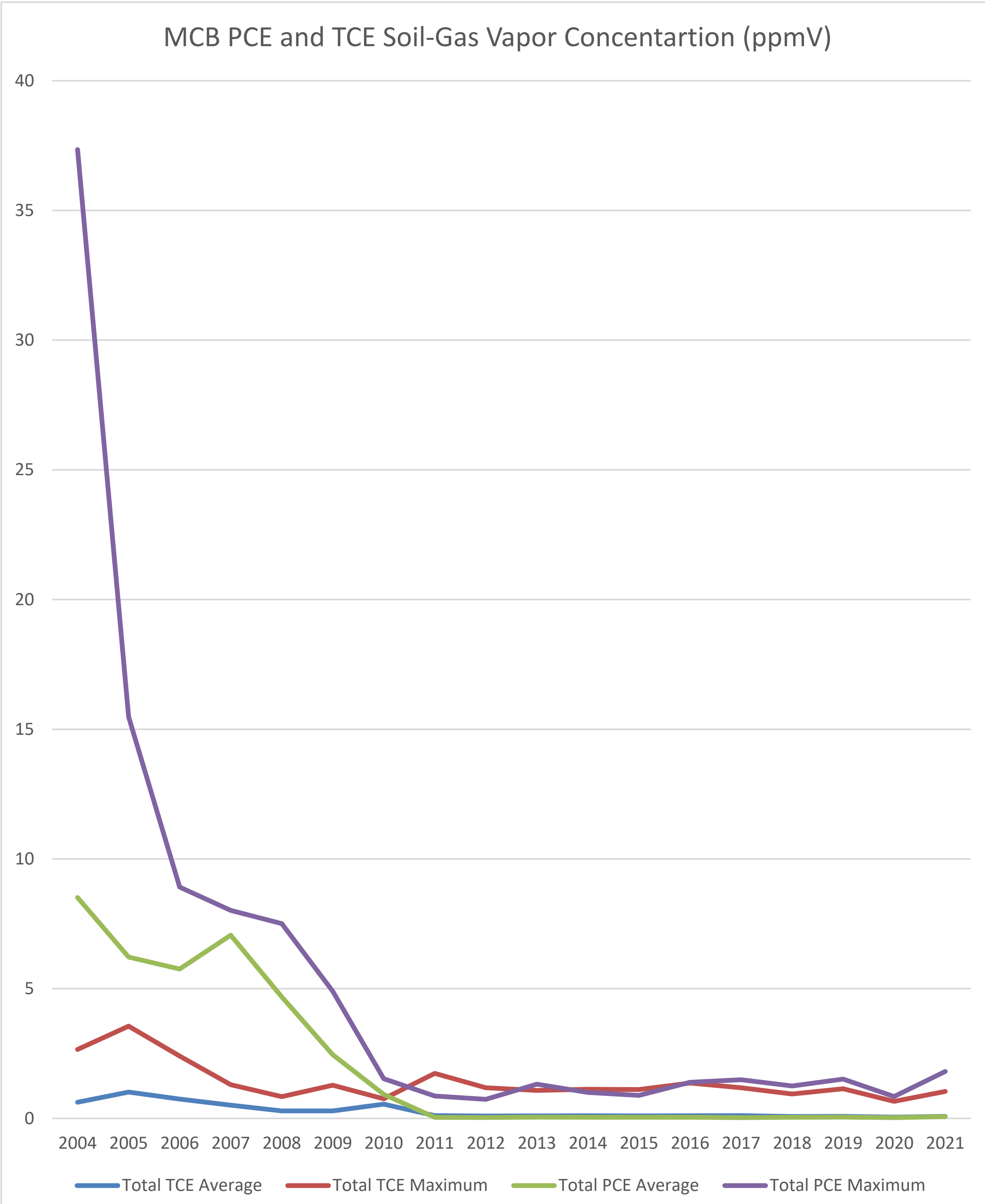

Figure 6. MCB Soil-Gas Vapor Concentration Over Time Trend Diagram

This page intentionally left blank.

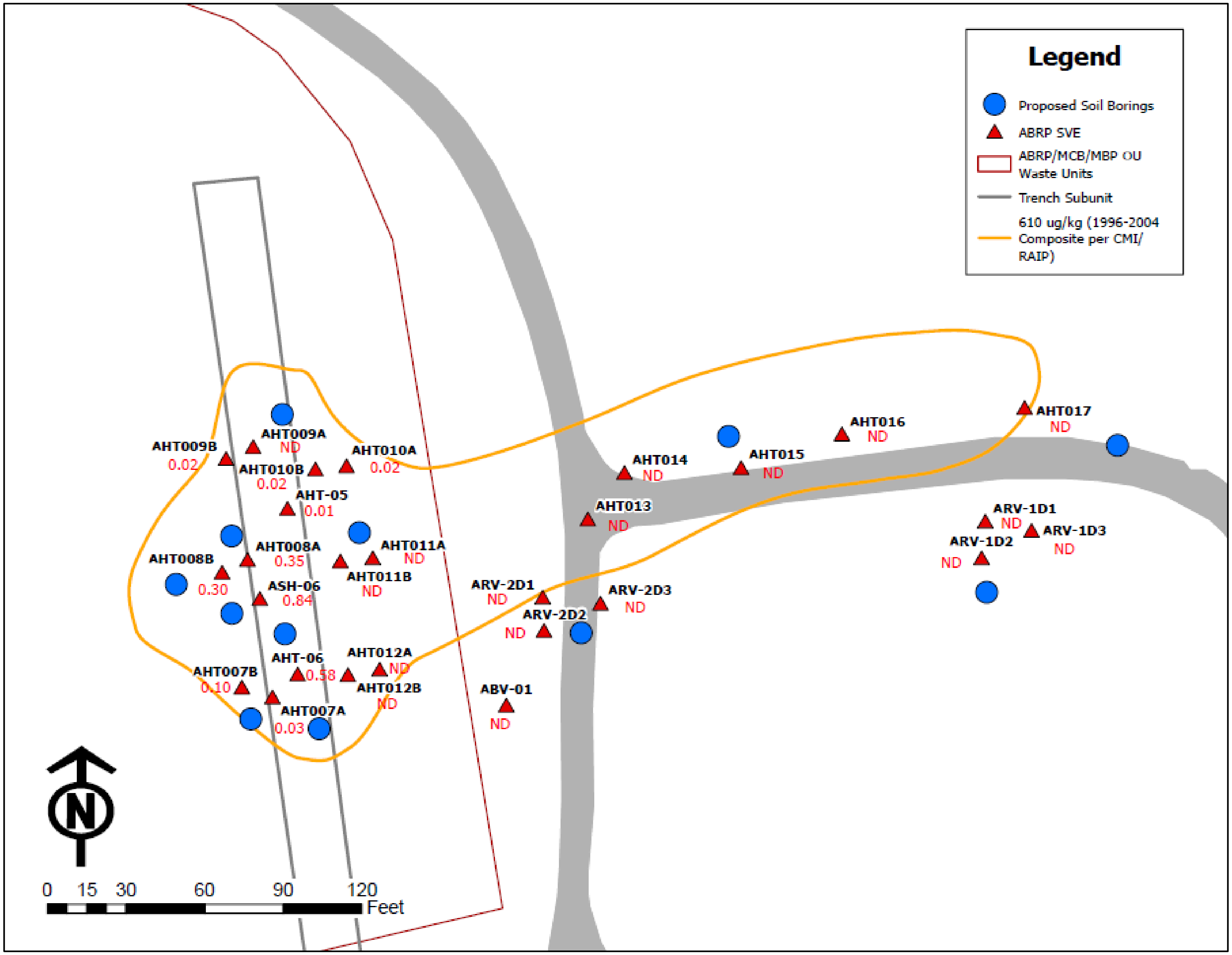

Figure 7. ABRP Proposed Soil Boring Locations with Maximum 2021 TCE Concentrations (ppmv)

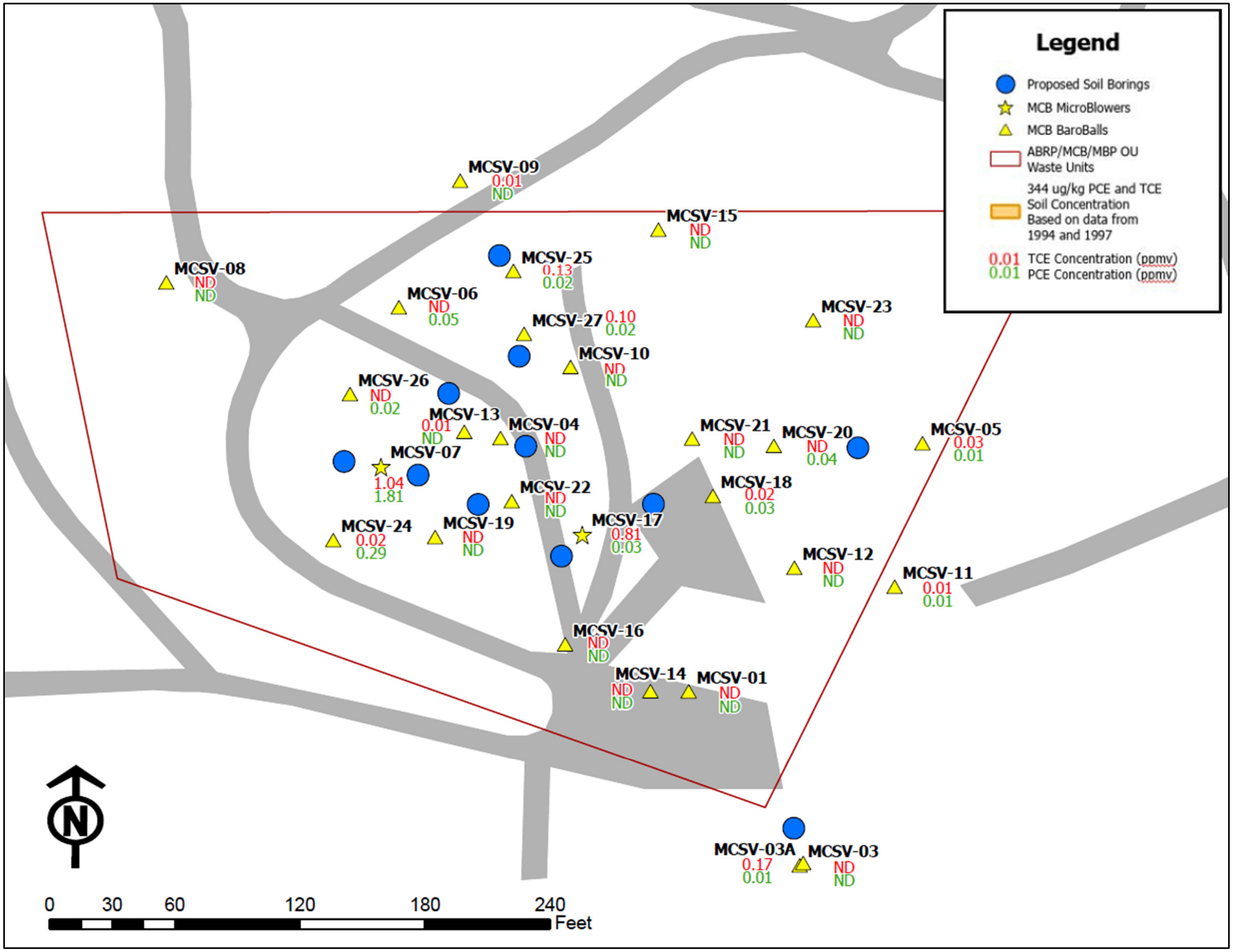

Figure 8. MCB Proposed Soil Boring Locations with Maximum 2021 TCE and PCE Concentrations (ppmv)

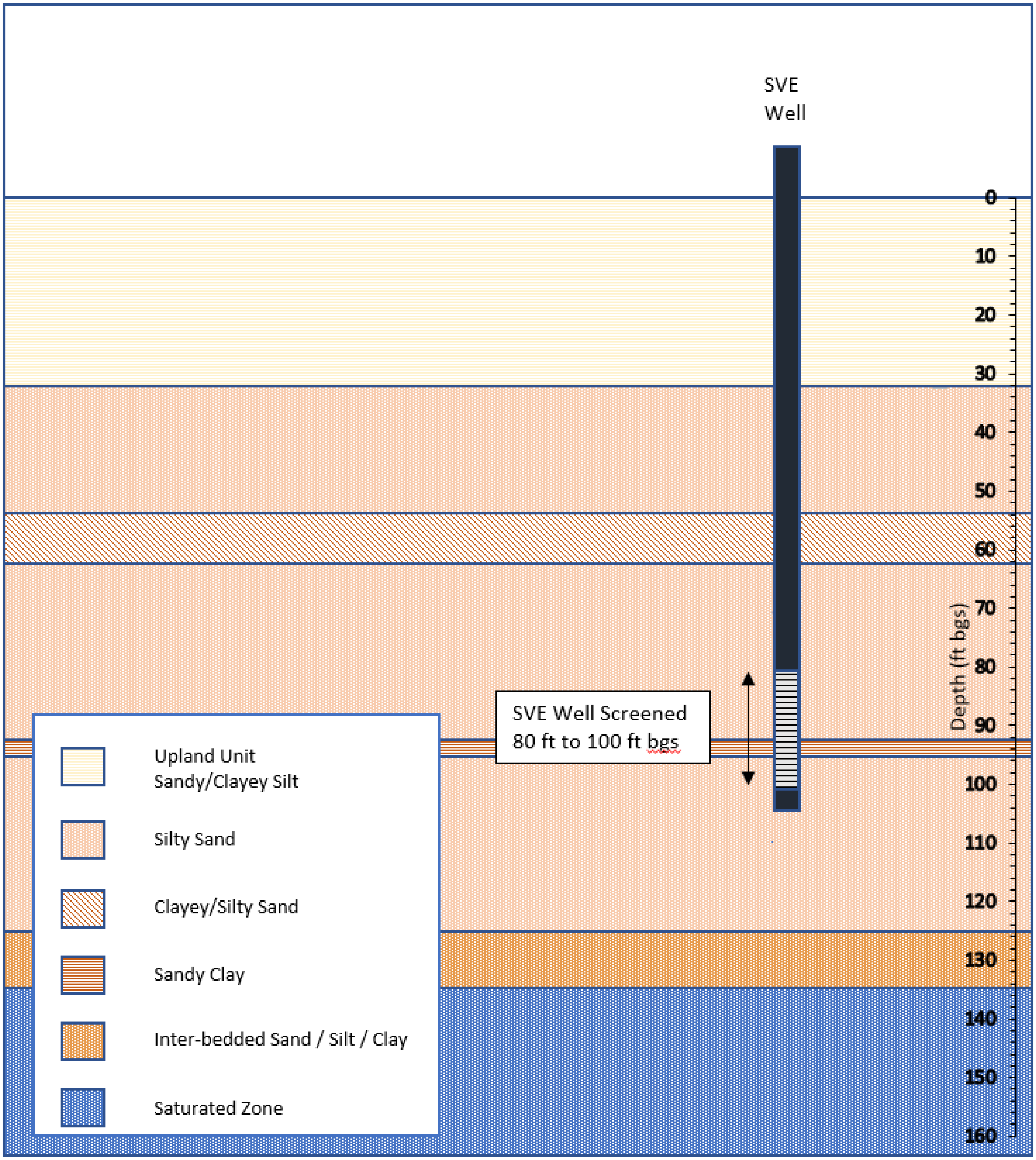

Figure 9. Hydrostratigraphic Column Diagram

Table 1. Summary of Remedial Goals for ABRP

Refined COC		**Risk-based RG**
	Units	**Final CM RG**
TCE	µg/kg	610

Table 2. Summary of Remedial Goals for MCB

Refined COC		**Risk-based RGs**
	Units	**Final RG**
TCE	µg/kg	344
PCE	µg/kg	344

Table 3. Data Quality Objectives Worksheet for Soil Media

Pathway (Media)	**Probable Conditions**	**Exposure Pathway and/or Release Mechanisms**	**Data Needs and DQOs**	**Field Activities**	**Parameters**
Subsurface Soil	Low levels of residual contamination exist in ABRP/MCB/MBP subsurface soils.	Contaminant migration to groundwater.	Compare measured concentrations of contaminants in soil to RGs established in the ROD.	Soil samples taken every 0.61 to 1.5 m (2 to 5 ft).	Definitive Data Quality Level TCE and PCE.

Table 4. Sampling Matrix Table

ABRP Sampling Matrix				
Station ID	Cored Interval (ft bgs)	Proposed TD (ft bgs)	Sample Media	# of Samples
ABRP-001-SB	15-120	120	Soil	21
ABRP-002-SB	15-120	120	Soil	21
ABRP-003-SB	15-120	120	Soil	21
ABRP-004-SB	15-120	120	Soil	21
ABRP-005-SB	15-120	120	Soil	21
ABRP-006-SB	15-120	120	Soil	21
ABRP-007-SB	15-120	120	Soil	21
ABRP-008-SB	15-120	120	Soil	21
ABRP-009-SB	15-120	120	Soil	21
ABRP-010-SB	15-120	120	Soil	21
ABRP-011-SB	15-120	120	Soil	21
ABRP-012-SB	15-120	120	Soil	21
MCB Sampling Matrix				
Station ID	Cored Interval (ft bgs)	Proposed TD (ft bgs)	Sample Media	# of Samples
MCB-001-SB	15-120	120	Soil	21
MCB-002-SB	15-120	120	Soil	21
MCB-003-SB	15-120	120	Soil	21
MCB-004-SB	15-120	120	Soil	21
MCB-005-SB	15-120	120	Soil	21
MCB-006-SB	15-120	120	Soil	21
MCB-007-SB	15-120	120	Soil	21
MCB-008-SB	15-120	120	Soil	21
MCB-009-SB	15-120	120	Soil	21
MCB-010-SB	15-120	120	Soil	21
MCB-011-SB	15-120	120	Soil	21

Regular Samples	483
Field Duplicates	25
Split Samples	25
Field Blanks	13
Trip Blanks	1 per cooler

Table 5. Laboratory Analytical Specifications for Target Compound List Analytes for Soil Media

Analyte	Analyte ID	Preparation[B] Method	EPA[B] Method	CRDL[A] *(mg/kg)*
Analyte List				
Volatiles				
Trichloroethylene (TCE)	79-01-6	5035A	EPA8260B	0.00137
Tetrachloroethylene (PCE)	127-18-4	5035A	EPA8260B	0.00142

A) CRDL is the Contract Required Detection Limit and is not always attainable.
B) Extraction and preparation methods differ depending upon media, concentration, instrument, laboratory, and analytical method. Preparation methods will also influence detection limits.

Table 6. Preservatives, Holding Times, and Sample Containers

Parameter	Preservatives	Holding Time	Containers
	Solid	Solid	Solid
Volatile Organic Compounds (VOCs) Including: 8260 – VOCs	Low-level soil Add approximately 5 g soil to 40 mL VOA vial preserved with 1 g of $NaHSO_4$/5 mL water High-level soil Add approximately 5 g soil to 40 mL VOA vial preserved with 5 mL methanol	Low/High Level 14 days	3x40 (or 60) mL glass VOA vial (with stir bar for low-level soil), PTFE septa cap

g = gram
L = liter
mL = milliliter
VOA = volatile organic analysis

Table 7. Field Quality Control/Quality Assurance Sampling Requirements

Data Quality Levels	Field Quality Control/Quality Assurance Samples	Frequency of Field Quality Control/Quality Assurance Samples
Definitive (D)	Co-located Field Duplicate	Minimum 5%[1]
	Trip Blank	1 per cooler
	Field Blank	Optional; 1 per 40 samples[2]
	Split Sample	Minimum 5%

Data Quality Levels
D Data USEPA Definitive Level Data

Footnotes:
1.) Minimum frequency established per ER-SOP-043
2.) Recommended based on project needs; typical frequency