FINAL

LONG-TERM MONITORING AND MAINTENANCE PLAN

FOR AREA OF CONTAMINATION A7

FORMER SUDBURY TRAINING ANNEX

SUDBURY, MASSACHUSETTS

JULY 2020

Prepared for:

U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742

Prepared by:

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100
Marlborough, MA 01752

Contract No.: W912WJ-18-C-0011

NOTICE

The United States Department of Defense, Department of Army, funded wholly or in part the preparation of this document and work described herein under Contract No. W912WJ-18-C-0011. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

LONG-TERM MONITORING AND MAINTENANCE PLAN FOR AREA OF CONTAMINATION A7

FORMER SUDBURY TRAINING ANNEX

DRAFT FINAL

JUNE 2020

CERTIFICATION:

I hereby certify that the enclosed Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W912WJ-18-C-0011. This document was prepared in accordance with the U.S. Army Corps of Engineers (USACE) Scope of Work and is hereby submitted for Government Approval.

Reviewed By:

06/02/2020

KGS Project Manager **Date**

Received By:

REDDY.PENELOPE.W.1502105066 Digitally signed by REDDY.PENELOPE.W.1502105066 Date: 2020.06.02 08:49:51 -04'00'

USACE Project Manager **Date**

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACROYMNS OR ABBREVIATIONS

ADR	Automated Data Review
AOC	area of contamination
Army	U.S. Army
ASTM	American Society for Testing and Materials
bgs	below ground surface
BRAC	Base Realignment and Closure
ºC	degree Celsius
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CMR	Code of Massachusetts Regulations
COC	contaminant of concern
COD	chemical oxygen demand
DCL	Devens Consolidation Landfill
Devens	former Fort Devens Army Installation
DO	dissolved oxygen
DoD	Department of Defense
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
EDD	electronic data deliverable
eQAPP	electronic Quality Assurance Project Plan
ESD	Explanation of Significant Differences
FEMA	Federal Emergency Management Agency
FS	Feasibility Study
FTP	file transfer protocol
FYR	five year review
GPS	Global Positioning System
HGL	HydroGeoLogic, Inc.
HLA	Harding Lawson Associates
ID	identification
IDW	investigation-derived waste
ITRC	Interstate Technology and Regulator Council
KGS	KOMAN Government Solutions, LLC
L/min	liters per minute
LEL	lower explosive limit

LCS	laboratory control sample
LTM	long-term monitoring
LTMM	long-term monitoring and maintenance
LTMMP	Long-Term Monitoring and Maintenance Plan
LUC	Land-Use Control
LUCIP	Land-Use Control Implementation Plan
µg/L	micrograms per liter
MAROS	Monitoring and Remediation Optimization System
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
mg/kg	milligrams per kilogram
MOA	Memorandum of Agreement
MS	matrix spike
MSD	matrix spike duplicate
MWPAR	Massachusetts Wetlands Protection Act Regulations
NAD	North American Datum
NVGD	National Vertical Geodetic Datum
NFA	No Further Action
NFG	National Functional Guidelines
NPL	National Priorities List
NTU	nephelometric turbidity units
O&M	operations and maintenance
ORP	oxidation-reduction potential
OU	Operable Unit
%	Percent
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PID	photoionization detector
PM	Project Manager
POL	petroleum, oils, and lubricant
PPE	personal protective equipment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QSM	Quality Systems Manual
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	record of decision
SEDD	Staged Electronic Data Deliverable

SOW	Statement of Work
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOA	volatile organic analyte
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 PURPOSE

The U.S. Army Corps of Engineers (USACE)-New England District contracted KOMAN Government Solutions, LLC (KGS) to conduct environmental remediation services required to meet the objectives of the Statement of Work (SOW) for Contract Number W912WJ-18-C-0011. KGS has prepared this Long-Term Monitoring and Maintenance Plan (LTMMP) for Area of Contamination (AOC) A7 to update the current long-term monitoring (LTM) approach for the former Sudbury Training Annex ("the Annex"). Updates to the LTM approach are warranted to account for changes in contaminant distribution and progress towards achieving the goals stated in the Record of Decision (ROD) (OHM, 1995) and the ROD for Management of Migration (ABB, 1997). This LTMMP updates and supersedes the Sudbury Annex portion of the 2015 *Devens and Sudbury Annex Long-Term Monitoring Plan* (Sovereign/HGL, 2015) with additional revisions and optimization recommendations included based on current conditions at the Annex.

The LTM optimization recommendations provided in this revised LTMMP are derived in part from the Optimization Evaluation (Sovereign, 2015) for the Annex and are provided here to document changes to the sampling program. This LTMMP revision includes the optimization recommendations determined during performance of the optimization evaluation (see Appendix A of the 2015 LTMMP, Sovereign, 2015) and does not reproduce the in-depth discussions contained within the optimization report.

AOC A7 is the only AOC at the Annex with an existing Remedial Action including operation and maintenance, institutional controls, and land use restrictions. No monitoring or land use controls were specified for AOC A9 in the RODs. AOC P31 was the subject of a No Further Action decision in April 1999 following conclusion of the Final *Supplemental Site Investigation Report* (HLA, 1999). Groundwater at AOC P58 was monitored by the Army through May 2001 per a 1999 addendum to the existing LTMMP for AOC A7 (USACE, 1998); however, groundwater monitoring at AOC P58 ceased in 2002 and all four monitoring wells were decommissioned and no further action is required.

1.2 BACKGROUND

The Annex was listed as a National Priorities List (NPL) site from February 1990 through January 2002, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The former training annex occupies approximately 4.3 square miles in the towns of Hudson, Marlborough, Maynard, Stow, and Sudbury, Massachusetts. Hudson Road divides the installation into a larger northern section, and a smaller southern section (**Figure 1-1**). The Annex became part of the Fort Devens Army Installation in 1982. The Annex was removed from the NPL in January 2002. At that time, 2,205 acres of the property were transferred to the U.S. Fish and Wildlife Service (USFWS), 4.1 acres were transferred to the U.S. Air Force (USAF), and 71.4 acres were transferred to the Federal Emergency Management Agency (FEMA). In June 2002, all known monitoring wells at the former annex were decommissioned except for those at Area of Contamination (AOC) A7, which required continued investigation under a long-term monitoring and maintenance (LTMM) program.

AOC A7 is a 10-acre site located by the Assabet River in the northern portion of the Annex (**Figure 1-1**). The site layout of AOC A7 is shown on **Figure 1-2**. AOC A7 is the only site remaining at the Annex that requires continued environmental sampling. AOC A7 is a former waste disposal site that was used as a landfill for general refuse, demolition debris, and chemical lab waste disposal. The lab waste area was limited to a pit of about 5,000 square feet within the landfill. General refuse was reportedly buried at shallow depths from 1941 until the 1980s, with occasional burning to reduce volume. The laboratory waste was excavated in 1996 and transported offsite for treatment and disposal at an approved facility. The laboratory waste was removed because it is considered to be the primary source of groundwater contamination at the site. The Army constructed a Resource Conservation and Recovery Act (RCRA) Subtitle C (impermeable) landfill cap in 1996 following the removal of the waste. The Army has completed Remedial Investigations (RIs), Feasibility Study (FS), a Source Control ROD, and a Management of Migration ROD for AOC A7. The Army has been conducting long-term monitoring and maintenance at AOC A7 since that time.

1.3 ROD OBJECTIVES AND SELECTED REMEDY

The LTMMP strategies implemented at the Annex are driven by the requirements in the ROD. In general, the objectives of the monitoring and maintenance program at the Annex are to monitor groundwater conditions on-site, monitor for potential off-site contaminant migration, and to document that concentrations of the contaminants of concern (COC) decrease over time to a level that achieves the objectives stated in the ROD. A description of current site LTMM activities is provided in Section 2.0.

The remedial action objectives (RAOs) established in the ROD are site-specific, quantitative goals defining the extent of cleanup required to achieve response objectives. The RAOs are formulated to achieve the overall U.S. Environmental Protection Agency (USEPA) goal of protecting human health and the environment.

The ROD for the Source Control of the Operable Units (OU) 1 and 2 at AOCs A7 and A9 was signed in September 1995 (ABB, 1997). The ROD for Management of Migration for OUs 1, 2, and 3 (AOCs A4, A7, and A9) was signed in September 1997 (OHM, 1997). The following RAOs were developed to mitigate existing and future potential threats to public health and the environment:

- Eliminate potential risk to human health and the environment associated with exposure to contaminated wastes;
- Minimize off-site migration of contaminants; and,
- Limit infiltration of precipitation to the underlying waste within the landfill area, thereby minimizing leachate generation and groundwater degradation (OHM, 1995).

The remedy selection for the source control OU for AOC A7 was the installation of an impermeable landfill cover system that met RCRA Subtitle C requirements. The landfill remedy also included the following:

- removal and off-site disposal of chemical waste debris in the laboratory dump area;
- operations and maintenance (O&M);
- Land Use Controls (LUCs) and land use restrictions;
- long-term groundwater monitoring; and
- five-year reviews to assess whether the remedy remains protective of human health and the environment.

The selected remedial action also specified the creation of a wetland at AOC A7 in fall 1996 to replace "Wetland B", which was a seasonal wetland that is now incorporated as part of the landfill. Wetland B was classified as a natural resource area under the Massachusetts Wetlands Protection Act Regulations (MWPAR), as an "Isolated Land Subject to Flooding". Based on size (40 feet by 60 feet [ft], or 2,400 ft^2), Wetland B was not subject to regulation under the MWPAR. Nonetheless, the decision to replace Wetland B was made in accordance with the USACE policy of "No Net Loss of Wetlands" and the requirements of Army Regulation 200-3 (Natural Resources - Land, Forest and Wildlife Management). Post-construction inspections in 1997 found that the wetland had been successfully established and no further action was recommended. Subsequent inspections in 2000 and 2004 similarly concluded that the area had been successfully restored to a functioning wetland.

1.4 MASSACHUSETTS SOLID WASTE LANDFILL REGULATIONS

The landfill at AOC A7 was constructed in 1996 and has been in operation since 1996 (23 years). Massachusetts landfill post-closure requirements are specified under 310 Code of Massachusetts Regulations (CMR) 19.142 and include a minimum 30-year post-closure period. During the post-closure period, the landfill owner/operator must perform site maintenance, conduct environmental monitoring, maintain the landfill gas control system, and conduct periodic site inspections. The Army has been performing these activities, as described in the site LTMMPs, since 1996 (23 years) and will continue these activities through the 30-year period (2026) unless a waiver is sought in accordance with 310 CMR 19.142(3). After the 30-year period, the Army can apply for termination of the post-closure period in accordance with 310 CMR 19.142(8) and/or will reduce the LTMM program depending on site conditions at that time.

Post-closure changes to the LTMM are not proposed at this time, however, potential future modifications to the LTMM program after the 30-year period may include the following:

- Ceasing landfill gas monitoring if methane levels remain low. Currently, the landfill gas vents are sampled once every five years in support of the Five-Year Review (next sampling is planned for fall 2020). As a mature landfill, methane generation appears to have greatly slowed or stopped. Methane concentrations in the gas vents were very low to non-detect during the most recent gas vent samplings conducted in 2016 (maximum 0.2% methane) and 2017 (non-detect).

- Ceasing groundwater monitoring if COC concentrations are below cleanup levels. During the most recent (November 2019) sampling event, there were no exceedences of cleanup goals in the downgradient sentinel well SUDWP-A07-01[1], as VOCs and pesticides were non-detect and there were only very low levels of cyanide and chemical oxygen demand (COD). If insufficient data are available for complete cessation of the monitoring program at the end of the post-closure period, then the sampling frequency may be reduced to coincide with the Five-Year Reviews.

- Reducing or ceasing landfill maintenance. Annual inspections have found no significant structural/erosional problems with the landfill. After the 30-year post-closure period, annual inspections and mowing may no longer be required except perhaps the periodic removal of deep-rooted vegetation on the cap (i.e., large trees) and/or inspections coinciding with the Five-Year Reviews.

[1] Replaced by well SUD-A7-19-01 in 2019.

2.0 LONG-TERM MONITORING AND MAINTENANCE PROGRAM

This section provides a summary of the current LTMM program implemented at the Annex, and summarizes the recommended optimization strategy for the site where optimization is appropriate based on changes in site conditions or progress made towards achieving the goals stated in the ROD. The Optimization Evaluation (Sovereign, 2015) provided a detailed discussion of the rationale for the selected optimization approach and is not reproduced within this section; however, the Army's rationale for implementing LTM optimization can be summarized by the following:

- The LTM sites do not pose a risk to human health and the environment based on the lack of an exposure pathway. LUCs are in place and historical groundwater monitoring data indicate that the concentrations of COC are either stable, or in most cases, steadily declining since inception of the monitoring program.
- The LTM site conditions (as established by prior removal actions), remaining source/groundwater COCs concentrations, and current and historical monitoring data do not indicate (and are not conducive to) any significant contaminant migration beyond the boundary of the monitoring networks.

The recommended changes to the monitoring well network and/or sampling frequency of wells within the site's monitoring program, where indicated, are based on the need to properly define plume extent and/or monitor changes in the plume composition over time. Wells were selected for elimination if the sampling point/data collected from the sampling point was determined to not add value to the monitoring program. The frequency of monitoring was reduced at other wells where frequent monitoring did not enhance the site's data set and the groundwater from a particular well had established a defined concentration trend and did not show evidence of rapid contaminant or geochemical variations between sampling events. Other wells were selected for reduced sampling frequency where data have shown little change over time but data from the particular well would help to confirm plume delineation. A statistical analysis of data trends was performed through the Monitoring and Remediation Optimization System (MAROS) program (Sovereign, 2015) and the analysis supported the proposed changes where reduction in frequency was recommended. Since 2015, a review of chemistry trends was performed to align site conditions to monitoring needs.

2.1 PREVIOUS AND UPDATED LONG-TERM MONITORING AND MAINTENACE PROGRAM

The current program, which was last revised in 2018 (KGS, 2018a), includes annual sampling of one downgradient well (SUD-A7-19-01) and biennial (every other year) sampling of four wells: OHM-A7-08 (landfill well), SUD-A07-065 (downgradient well), SUD-A07-014 (upgradient well) and SUD-A7-19-01 (downgradient well). Samples are analyzed for VOCs, organochlorine pesticides, total cyanide, and chemical oxygen demand (COD). The samples are collected during the Army's fall LTM event (October/ November).

The four, 6-inch landfill gas vents are to be monitored once every five years (next event in 2020) using a handheld meter (MultiRAE or GEM 2000) for total VOC levels, hydrogen sulfide, lower explosive limit (LEL), carbon dioxide, carbon monoxide, oxygen, and methane.

The depth to water is measured at 13 monitoring wells and at one of two staff gauge surface water locations during each annual and biennial LTM event.

Landfill maintenance is also performed annually and includes lawn mowing, clearing of debris from fence line, and ensuring the toe drain, as well as the riprap areas, are clear of moss and excess sediment. If necessary, herbicide is applied to areas encroached with invasive vegetation.

Because there is no active or passive remediation in progress at the landfill, the performance metric will consist of evaluating the annual LTM data against established COC trends. The collection frequency of landfill gas monitoring results is every five years, prior to the Five-Year Reviews. The next Five-Year Review is scheduled for 2021.

Over time, the landfill also will be evaluated for transition from Post-Closure Care to Custodial Care per the ITRC guidance.

2.1.1 Current Evaluation of LTM Data to COC Trends in Groundwater

Evaluation of contaminants of concern trends in groundwater since the landfill cap was construction in 1996 through fall 2019 are summarized below. It should be noted that groundwater is not used as a source of drinking water at AOC A7 and groundwater discharges to the Assabet River. The AOC A7 ROD did not include groundwater RAOs, ARARs, or specific cleanup levels. To assess the data and trends, groundwater concentrations are compared to the state and federal standards in Table 3-4 and discussed below:

- 1,1,2,2-Tetrachloroethane – 1,1,2,2-Tetrachloroethane results have been reported for 20 years beginning in July 1996 and ending in October 2016. In 18 years of sampling at well OHM-A7-51, the concentrations have decreased significantly. The downward trend began in April 1997 with concentrations reported below the Massachusetts Contingency Plan (MCP) GW-1 standard of 2.0 µg/L from November 2009 to November 2013. This contaminant is unregulated under the federal National Primary Drinking Water regulations and no MCL has been established. In 20 years of sampling at Well JO-A07-M63/SUD-A07-065, 1,1,2,2-tetrachloroethane concentrations increased until 1998 following a steady decrease until levels were below the GW-1 standard in 2015.
- Tetrachloroethene – Tetrachloroethene results have been reported for 21 years beginning in July 1996 and ending in November 2019. No results were reported in 2016 and 2017. OHM-A7-08 showed elevated levels of tetrachloroethene from July 1996 until October 1998 when concentrations began to decline. The highest tetrachloroethene concentration at this well was reported in October 1998 at 130 µg/L. October 2015 marked the first sampling result below the federal MCL and MCP GW-1 standard of 5.0 µg/L. Well OHM-A7-51 concentrations dropped dramatically in 1996. By 2004, levels were first reported below the GW-1 standard. The tetrachloroethene results from 2004 until 2013 were reported below the federal and state standard and the location has not been sampled since. Well JO-A07-M63/SUD-A07-065 has experienced both upward and downward trends in the 21 years of collected samples and will require further sampling until results are below the GW-1 standard.
- Trichloroethene – Trichloroethene results have been reported for 20 years beginning in July 1996 and ending in October 2016. Throughout 20 years of sampling, JO-A07-

M63/SUD-A07-065 has not developed a clear trend. Results have increased and decreased without an established trend. From 2006 to 2016; however, levels began to plateau and results were reported below the federal MCL and MCP GW-1 standard of 5.0 µg/L. Because of the variance in trends with trichloroethene, evidence points to further sampling until results are below the standard.

- Gamma-BHC (Lindane) – Lindane results have been reported at three different wells over the course of 23 years. Well OHM-A7-08 has been experience a downward trend throughout 21 years of results. From 1996 until 2001, Lindane was experiencing an upward trend. After 2001, Lindane concentrations continued to drop until results were below the federal MCL and MCP GW-1 standard of 0.2 µg/L in 2015. Well SUD-A07-065 has had low concentrations with little variance and the results over the past three rounds have not exceeded the standard.

If concentrations continue to remain below the federal and state regulatory standards and/or show downward concentration trends, then as part of the 2021 Five Year Review, the Army may propose further reductions in the sampling frequency (e.g., sampling of the four wells every 2 to 5 years).

This page is intentionally left blank.

3.0 SAMPLING AND ANALYSIS PLAN FOR GROUNDWATER

This section constitutes a project-specific sampling and analysis plan and was prepared in accordance with the guidelines set forth in the USACE Engineer Manual (EM) *EM200-1-2, Technical Project Planning Guidance for HTRW Data Quality Design* (USACE, 1995); *EM 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans* (USACE, 2001); and USEPA, Region 1, *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (USEPA, Region 1, 2017).

3.1 OBJECTIVES

The following subsections were developed to ensure that data quality objectives specific to this project are met; field sampling protocols are implemented, documented and reviewed in a consistent manner; and data collected are scientifically valid and defensible.

3.2 MONITORING WELL SAMPLING

Based on recommendations from the Optimization Evaluation (Sovereign/HGL, 2015) and current site conditions, groundwater samples from the following AOC A7 monitoring wells will be collected at the given frequency during the fall (October-November):

- Annual sampling of downgradient well SUD-A7-19-01
- Biennial (every other year) sampling of wells OHM-A7-08, SUD-A07-014 and SUD-A07-065, beginning in 2021 (then 2023, etc.)

Groundwater monitoring wells selected for LTM and the rationale for their selection are summarized in **Table 3-1**. Groundwater monitoring wells were selected to confirm the absence or presence of COCs at downgradient locations or to document the anticipated decrease in COCs over time within source areas at AOC A7. Historical groundwater sampling results also were used to select groundwater monitoring wells for LTM.

The location of groundwater monitoring wells that are included in fall LTMM sample event for sample collection within AOC A7 are identified in **Figure 1-2**. The locations that will be sampled and the sample methods to be used during LTMM sample events are listed in **Table 3-2**.

3.3 LANDFILL GAS VENT MONITORING

A passive gas venting system was installed at Sudbury landfill to facilitate the ventilation of any methane generated from the degradation of waste material beneath the landfill cover system.

The passive system for Sudbury consists of four 6-inch diameter gas vents. Gas vent locations are depicted on **Figure 1-2**. Screens were installed at the end of each vent pipe to prevent access by birds or other animals. Field monitoring is performed at the landfill gas vents for carbon dioxide, oxygen, and methane. Barometric pressure is also measured. A LandTec GEM-500 or equivalent gas monitor is typically used to monitor the gas vents. Landfill gas parameters are collected by inserting the monitoring equipment intake tube into the landfill gas vent and recording the parameter values after 1 to 2 minutes. The monitoring equipment intake tube is inserted past the landfill gas vent elbow to ensure that the parameters are reflective of landfill gas and not ambient air. Landtec calibration procedures are included in **Appendix A**. The gas monitoring field form is included in **Appendix B**.

3.4 SAMPLING FREQUENCY SUMMARY

Based on the Optimization Evaluation recommendations (Sovereign/HGL, 2015) and recent data trends through fall 2019, the LTM sample event includes annual sampling from one well and biennial sampling from four wells. Field monitoring of the AOC A7 landfill gas vents will be performed every five years for AOC A7. Specific analytical methods and analytes are discussed in Section 3.5.

3.5 ANALYTICAL METHODS AND ANALYTES

Analytical methods and analytes utilized for the LTM sample event will be in accordance with this document and the Generic Quality Assurance Project Plan (QAPP) (KGS, 2016). Analytical detection limits are lower than the project action levels (see QAPP Worksheet #15 for Reference Limits and Evaluation table for specific analytes). **Table 3-3** lists the analytical parameters, sample container quantities, preservation, holding times and quality control (QC) samples required for groundwater monitoring. The sample methods for groundwater monitoring are presented in **Table 3-2**. Action levels to be used in the assessment of potential COC off-site migration are presented in **Table 3-4**. Specific analytical parameters and methods to be used during LTM sample event are summarized below.

3.5.1 Groundwater Analytical Methods and Analytes

The following groundwater laboratory and field parameters will be performed or collected during the LTM sample event at the AOC A7 landfill:

- VOC (SW-846 method 8260B [SW8260B])
- Pesticides (SW-846 method 8081A [SW8081A])
- COD (410.4)
- Cyanide (SM4500CN-CE)

Field measurements will be collected during groundwater monitoring low-flow well purging activities to compliment laboratory analytical methods. Specific parameters will include pH, temperature, specific conductance, DO, ORP, and turbidity. The collection of field measurements is discussed in Section 3.7.2.

3.6 PRE-SAMPLING ACTIVITIES

The Groundwater Sampling Checklist presented in **Appendix C** summarizes action items that need to be performed before and during the LTM sample event to ensure that LTM tasks are completed. The following sections provide a more detailed discussion of the pre-sampling activities that will be conducted prior to the collection of groundwater samples at the Annex.

3.6.1 Equipment and Supplies

The following equipment and supplies will be utilized in the collection of low-flow groundwater samples:

- Geotech Peristaltic pump and Teflon®-lined tubing,
- Water level indicator,

- DO, pH, specific conductance, ORP and temperature probes (within a single unit) and appropriate calibration solutions, turbidity meter (separate meter from the above unit), flow-through cell,
- Certified clean sample containers with preservative, provided by the subcontract analytical laboratory.
- Decontamination supplies including isopropyl alcohol and Alconox detergent,
- Laboratory grade deionized water,
- 500-milliliter graduated cylinder,
- Graduated 5-gallon buckets for purge water and decontamination,
- Plastic Ziploc® sealable bags,
- 0.45 micron in-line filters,
- Well and gate keys,
- Field logbook and field sampling forms,
- Chain of custody forms,
- Cooler with packing material and ice to cool all samples to 4 degrees Celsius (ºC), +/- 2 ºC,
- Temperature blank for each cooler to be submitted to the laboratory,
- Trip blanks (VOCs only),
- Polyethylene sheeting, and
- Paper towels.

3.6.2 Site Location, Security and Access

The Annex is located within the Assabet River National Wildlife Refuge where access is restricted to the general public at AOC A7 and groundwater monitoring wells are located in a secured fenced area. Security measures will be enacted if evidence of tampering or suspicious damage is noted. Damage observed at sampling locations will be reported to the Army for appropriate action. Information to be reported will include a written description and photograph of each damaged sample location. Arrangements will be made to coordinate LTM activities at any groundwater monitoring wells that are located in areas whose ownership has been transferred from the Army to another entity in an effort to ensure that LTM activities are conducted in a timeframe that is acceptable to all stakeholders and the property owner. Sampling activities of the wells within security fencing at the Annex, will be coordinated through the property owner, USFWS.

3.6.3 Initial Well Opening and Inspection

Olfactory and visual observations will be made upon opening the well casing protective cap. All observations, including any observed odors, will be documented in the logbook and on the Static

Groundwater Elevation Form presented in **Appendix B**. The general condition of the protective cover, its associated concrete apron, well casing protective cap, and the well casing will be inspected and noted in the logbook. Any damage, evidence of tampering, or immediately necessary repairs will be communicated to the USACE-NAE Project Manager (PM) within 24 hours.

3.6.4 Water Level Measurements

Water level measurements will be collected at each groundwater monitoring well before purging and sampling activities are performed. Field personnel will wait approximately 1 hour after the opening of each monitoring well before water level measurements are collected to ensure that the well's water level has adequate time to equilibrate with atmospheric conditions. Water level measurements will be collected on the marked side of the riser pipe and will be accurate to the nearest 0.01 ft. Water level measurements will be collected on the north side of any riser pipe that has not been previously marked. Water level data will be recorded on a Static Groundwater Elevation Form (**Appendix B**). The water level probe end and tape will be decontaminated before use in the first well, between each well, between sample locations, and at the conclusion of sample activities in accordance with the procedures specified in Section 3.9.4. Total well depth measurements will be collected as part of the post-sampling activities described in Section 3.9.1. In some instances, however, total well depth measurements will be collected prior to the collection of water samples if information is not available for a particular well and is necessary to facilitate the correct placement of a groundwater sample pump.

3.7 SAMPLING PROCEDURES

3.7.1 Equipment Calibration

Some equipment that will be used during the LTM event will require periodic calibration to ensure optimum performance, including a LandTec GEM-500, a water quality meter, and a turbidity meter. This equipment will be calibrated in accordance with manufacturer's instructions before its initial use at the site and at the beginning of each workday thereafter. The equipment calibration also will be checked at the conclusion of each workday. Calibrations and the end of the day drifts will be documented on field forms included in **Appendix B**. The calibration procedure for the LandTec GEM-500 is included in **Appendix A**.

3.7.2 Low-Flow Well Purging

Each groundwater monitoring well will be purged in accordance with the USEPA Region 1 Guidance Document titled *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (USEPA, 2017), included as **Appendix D**, prior to sampling. The goal of low-flow purging and sampling is to remove stagnant water from the well and collect representative samples from the aquifer at near ambient conditions. A peristaltic pump will be used to purge the wells. Dedicated or disposable teflon-lined tubing will be used during purging and sampling activities.

The depth to water will be measured with a water level indicator in accordance with Section 3.6.4. Caution will be exercised to minimize disturbance of the well water. The dedicated or disposable tubing of the peristaltic pump will be placed into the well gently such that the intake will be located in the middle or slightly below the middle of the screened interval to ensure that most of the water will be pumped directly from the formation.

A properly calibrated water quality parameter probe will be fitted into the flow-through cell provided with the instrument with the included mounting hardware. The line from the pump will be attached to the barbed hose fitting on the bottom of the flow-through cell. A T-valve and spigot will be attached to the line from the in-well submersible pump prior to the flow-through cell for the purpose of collecting turbidity samples. A drain line will be attached to the top fitting of the flow-through cell to direct the effluent to a bucket.

The depth to water will be continuously recorded during purging and measurements will be recorded on the field sampling form and in the field logbook. Flow rates of 0.1 to 0.5 liters per minute (L/min) will be used for purging. The pump will be operated at a flow rate where minimal drawdown occurs during purging. The goal of low-flow purging is for the drawdown to be less than or equal to 0.3 ft.

Water quality measurements will be used as the basis for establishing the stabilization of the well water. Well stabilization parameters will include pH, specific conductance, temperature, ORP, DO and turbidity. Turbidity samples must be collected from a spigot placed on the sample tubing prior to the flow-through cell and measured with a stand-alone meter. The parameters will be measured every 5 minutes until stabilization of all parameters is achieved. Stabilization has been reached when pH measurements remain constant within 0.1 standard unit, specific conductance is constant within 3 percent (%), the temperature is constant within 3%, ORP is constant within 10 millivolts, dissolved oxygen is either constant within 10% for values above 5 milligrams per liter (mg/L) or below 5 mg/L for three consecutive readings and the turbidity is either constant within 10% for values above 5 Nephelometric Turbidity Units (NTU) or below 5 NTUs for three consecutive readings. Field measurements will be tabulated for comparison on the Groundwater Field Forms (**Appendix B**). Observations such as odors, color of water or the appearance of soil particles or iron floc will also be recorded on the Groundwater Field Sampling Data Sheet. Final measurements will be recorded in the sampling logbook.

If the water level drops more than the goal of 0.3 ft during purging, additional measures such as reducing the purge flow rate, will be enacted to reduce drawdown. These activities will be documented. Purging will continue until well stabilization parameters stabilize, the water level drops to the screened interval for wells with shorter screened intervals, or until the water level drops to the top of the pump for wells with longer screened intervals that encompass the pre-purging groundwater level. If the water level drops to the top of the pump or the screened interval, purging will be stopped and up to 24 hours will be allowed to pass for the well to recharge. The well will be sampled using low-flow sample collection procedures although it will not be purged and it will not be necessary for field parameters to stabilize.

It should be noted that one of the current LTM program wells at the Annex, OHM-A7-08 has a 15-foot screen interval, which is greater than the 10-foot guideline referenced in the USEPA Region 1 guidance document. This well will be purged until a minimum of three screen volumes are pumped from the well, or until purging has been conducted for a minimum of 2 hours. A notation will be made on the Groundwater Field Sampling data sheet if samples are collected when water quality parameter stabilization or purge volume criteria have not been met.

3.7.3 Sample Containers and Preservatives

Laboratory provided sample containers will be used during LTM event. The laboratory will provide pre-preserved sample containers as appropriate for the analysis to be performed. Field personnel will conduct a visual check to ensure that pre-preserved sample containers contain preservative. A summary of the sample containers, preservation, and holding times for water samples are presented in **Table 3-2**.

3.8 SAMPLE COLLECTION

Dedicated and disposable Teflon-lined tubing connected to a peristaltic pump will be used to collect samples from groundwater monitoring wells. The objectives and methods for this procedure are described in USEPA's Region 1 Guidance Document entitled *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from Monitoring Wells* (USEPA, Region 1, 2017) presented in **Appendix D**. The goal of sampling monitoring wells is to provide groundwater quality data that is representative of actual aquifer conditions with minimal alteration caused by inappropriate or variable sampling techniques. Typically, flow rates of 0.1 to 0.5 L/min are used; however, this is dependent on site-specific hydrogeology (USEPA, 2017).

Once groundwater quality parameters have stabilized, groundwater samples will be collected directly from the tubing connected to the pump. The sampling flow rate will be the same flow rate that was used during the purging process to maintain equilibrium between the well and the formation. The flow-through cell will be bypassed or disconnected during the collection of samples. Sample containers will be filled by allowing water from the pump to gently enter the containers with minimal disturbance. Sampling will begin with the collection of the VOC samples and continue collection for the remaining parameters. Collected sample containers will be stored in a cooler and placed on ice immediately. All samples will be labeled as described in Section 3.8.1 and immediately placed in a cooler with ice to maintain a sample temperature of approximately 2 to 6 °C.

3.8.1 Sample Identification

All samples will be assigned a unique field sample identifier. Field personnel will generate a label for each sample container that will contain the sample identifier, date and time of sample collection, the sampler's initials, analytical parameters, and type of preservation used. The sampler will initial any change in the label information prior to the sample collection.

A sample numbering system will be used to identify each sample collected and submitted for analysis. The purpose of the numbering system is to assist in the tracking of samples and to facilitate retrieval of analytical results. The sampling number will be used on sample labels, sample tracking forms, chain of custody forms (**Appendix B**), field logbooks, and for other applicable documentation. The field sample numbering system will follow the format used for previous LTM events and will include the suffix for month and year (e.g., OHM-A7-08_MONTHYEAR). The sample identification (ID) for groundwater monitoring wells will be the name of the particular groundwater monitoring well. Duplicate sample IDs will specify the AOC from which the sample was collected without revealing the parent sample ID to the laboratory. Matrix spike (MS)/matrix spike duplicate (MSD) sample IDs will be indicative of the parent sample ID. Examples are listed below:

Sample Location:	Sample ID:
AOC A7 Monitoring Well OHM-A7-08	OHM-A7-08_MONYR
Blind Duplicate from Monitoring Well SUD-A07-014	A7-Dup1
Matrix Spike from Monitoring Well OHM-A7-08	OHM-A7-08_MONYR-MS
Matrix Spike Duplicate from Monitoring Well OHM-A7-08	OHM-A7-08_MONYR-MSD

3.8.2 Quality Assurance/Quality Control Samples

Quality assurance/quality control (QA/QC) samples will be collected during each LTM event. The following sub sections specify the type and quantity of samples to be collected for QA/QC purposes.

<u>Duplicate Sample</u>

Field duplicate samples will be collected and submitted for analysis in conjunction with all analyses associated with primary field samples. Field duplicates are additional samples subjected to the same collection methods, preparation and analysis as the original sample but are identified with a unique identification number so that they are blind to the laboratory. These samples will be used to evaluate the precision of sample collection, field sample preparation and laboratory analysis. Blind field duplicates will be collected and analyzed at a frequency one per sampling event for all analyses or 10% if more than 10 samples are planned to be collected. The planned locations and numbers of duplicate samples are listed in **Table 3-2**.

<u>Rinsate Blank</u>

Sampling methods called for in this plan include the use of both dedicated and non-dedicated sampling equipment. Therefore, some gauging or sampling equipment will be used in more than one well and will require decontamination between uses. Rinsate blanks will be prepared and submitted for analysis to determine the potential for cross-contamination from the sampling equipment. Rinsate blanks will be prepared at a frequency of one per LTM event if non-dedicated equipment is used. Rinsate blanks are prepared by decontaminating the field equipment according to the procedure specified in Section 3.9.4.

<u>Trip Blank</u>

Trip blanks will be submitted to the laboratory in conjunction with VOC samples. Trip blanks are used to identify the potential for VOC contamination associated with sample shipment, containers, and storage. Trip blanks are prepared in the laboratory by filling preserved volatile organic analyte (VOA) vials with American Society for Testing and Materials (ASTM) Type II water and shipped to the field with the sample bottles. A set of trip blanks is included in each cooler containing samples for VOC analysis and returned to the laboratory with the environmental samples. The expected number of project trip blanks for the Annex monitoring program is listed in **Table 3.2**.

Matrix Spike/Matrix Spike Duplicates

MS/MSD samples will be submitted for the analyses in conjunction with primary field samples. Results from MS/MSD samples will be used to evaluate the potential for sample matrix interferences versus laboratory analytical errors as well as to assess the accuracy of the analysis. MS/MSD samples will be collected at a frequency of one per AOC for each analysis. Extra volume will be collected from sample locations for MS/MSD analyses. MS/MSD sample locations are listed in **Table 3.2**.

3.9 POST-SAMPLING ACTIVITIES

3.9.1 Total Well Depth Measurement

The total depth in each well will be measured and recorded following the collection of groundwater samples. Every effort will be made to minimize the physical disturbance of water in the monitoring wells. Water level data will be recorded on a Groundwater Field Sampling Data Sheet (**Appendix B**). The total depth measurements will be used to evaluate potential well screen failure or the need for well development. The water level probe end and tape will be decontaminated before use in the first well, between each well, between sample locations, and at the conclusion of sample activities in accordance with the procedures specified in Section 3.9.4.

3.9.2 Chain of Custody

Sample custody will be maintained at all times. A sample is considered to be in custody under the following situations:

- The sample is directly in sampler possession;
- The sample is clearly in sampler view;
- The sample is placed in a locked location; and
- The sample is in a designated secure area.

Documentation of the chain of custody of the samples is necessary to demonstrate that the integrity of the samples has not been compromised between collection and delivery to the laboratory. A chain of custody record to document the transfer of custody from the field to the laboratory will accompany each sample cooler. All information requested in the chain of custody record will be completed. If samples are shipped by an overnight courier, the air bill number assigned by the overnight courier will be listed on the chain of custody record. One copy of the custody form will be retained by the samplers and the original will be sealed in a plastic bag and placed inside the cooler. Upon receipt at the laboratory, the chain of custody forms will be reviewed, signed and a cooler receipt form will be completed. It is the responsibility of the laboratory to document the sample condition upon receipt.

3.9.3 Sample Delivery/Shipment to Laboratory

Sample containers will be placed inside sealed plastic bags as a precaution against cross-contamination caused by leakage or breakage. Bagged sample containers will be placed in insulated coolers with bubble wrap or other wrapping to eliminate the chance of breakage during delivery or shipment. Ice in plastic bags will be placed in the coolers to keep the samples between 2 and 6 ºC throughout storage and shipment.

Sample delivery or shipment will be performed in strict accordance with all applicable U.S. Department of Transportation regulations. The samples will be transported from the site to the laboratory by laboratory personnel or shipped to the laboratory by an overnight courier service. Arrangements will be made between the sampling contractor and the contract laboratory point-of-contact for samples that are to be delivered to a laboratory on a weekend so that holding times and cooler temperatures are not compromised.

3.9.4 Equipment Decontamination

Equipment or supplies that cannot be effectively decontaminated (e.g., sample tubing or rope) will be disposed of after sampling, if not dedicated. Gauging/sampling equipment will be decontaminated at the site before use, between sampling locations, and after its last use at the site. Decontamination of field equipment will be noted in the project logbook. If it is necessary to make decontamination procedural changes in the field, the changes will be noted in the logbook. Otherwise, a notation will be made each day that decontamination was conducted as specified in the project documents. Procedures for decontaminating sampling equipment that may be used at the Annex will be conducted in accordance with guidance specified in USEPA Region 1, 2017, *Low Stress (low-flow) Purging and Sampling Procedure for the Collection of Ground Water Samples from the Collection of Ground Water Samples from Monitoring Wells*. The procedure is summarized below:

Groundwater gauging equipment and non-dedicated sampling equipment and materials will be decontaminated using the following procedure:

- Potable water flush immediately after use
- Detergent scrub with brushes (Alconox or equivalent detergent) with solution changed periodically
- Potable or deionized water flush to remove all detergent solution with solution changed periodically
- Light spray down with isopropyl alcohol
- Distilled/deionized water flush
- Air dry
- Cover with aluminum foil (if not to be used immediately)

The water level probe and tape will be decontaminated by the above referenced procedure; substituting air drying with drying the probe tape with a clean paper towel. Equipment that cannot be adequately cleaned will be discarded.

3.9.5 Investigation-Derived Waste

This section identifies the methodology for the handling, sampling, and disposal of investigation-derived waste (IDW). All IDW will be handled in a manner consistent with USACE and

USEPA guidance for managing IDW for Site Investigations (SI) (USEPA, 1992) and applicable Federal and state regulations. IDW to be generated may include:

- Decontamination water,
- Well purge water, and
- Personal protective equipment (PPE).

The primary source of IDW will be well purge water and decontamination water. Visual and olfactory observations will serve as the initial screening of well purge water for possible contamination. Based on LTM historical analytical trends, purge water will not be screened with a PID and currently is discharged to the surrounding ground. However, if newly identified or historical concentrations increase, then purge water may be drummed and characterized as needed.

If IDW is drummed for offsite disposal (i.e., if new contamination has been observed by the methods above), then the IDW will be characterized as non-hazardous or hazardous waste. **Table 3-5** summarizes IDW analysis and sampling methods. Disposable drum thieves or bailers will be used to collect samples from IDW drums. Sampling documentation will follow the protocols detailed in Section 3.9 of this document. A composite waste characterization sample will be obtained from the IDW drum(s) and analyzed to determine whether the IDW meets the definition of a hazardous waste according to 40 CFR 261.

In general, the following procedures will be used to dispose of IDW:

- RCRA non-hazardous wastes (except disposable equipment and PPE) will be disposed of on-site when possible. Liquid wastes, such as monitoring well purge water from uncontaminated areas, will be poured onto the ground in the area of the monitoring well.
- RCRA non-hazardous and decontaminated disposable equipment and PPE will be double bagged and placed inside a dumpster for disposal.
- IDW that is characterized as RCRA hazardous waste will be disposed of at an appropriate licensed hazardous waste disposal facility in accordance with applicable Federal, state and local regulations.

All drums will be removed from the site by the sampling contractor. All required manifests for waste disposal will be completed by the contractor and signed by a site environmental representative. Site representatives will be given a 72-hour notice prior to any waste hauling activity. The contractor will be on site during all waste removal activities. The site's point-of-contact will be provided with an original and three copies of all manifests, destruction/disposal documents, and any analytical results within 30-day of disposal. Waste manifests will be signed by the site point-of-contact.

3.9.6 Data Validation

The objective of the data validation is to assess the performance associated with the analysis in order to determine the quality of the data, which will be accomplished by evaluating whether the collected data comply with the project requirements. The extent of the data validation performed will be dependent on the project DQOs and will be limited by the content of the laboratory data deliverables.

LTM data will be reviewed in accordance with *DoD General Data Validation Guidelines* (EDQW, 2018), *USEPA National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, 2017), *USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA, 2017) and the QAPP (KGS, 2016). The data will be evaluated for compliance to method guidelines and the following criteria, as appropriate:

- Adherence to specified holding times and sample preservation conditions;
- Detected constituents in the field and laboratory method blanks;
- Surrogate recoveries;
- Laboratory control sample (LCS)/LCS duplicate precision and accuracy;
- MS/MSD precision and accuracy; and
- Field Duplicate precision.

The data validation process is discussed in detail in Section 5.2.

3.10 FIELD DOCUMENTATION

3.10.1 Field Logbooks

During all site activities, field logbooks will be maintained to record information related to site activities, health and safety, level of protection worn and any upgrades, visitors to the site, sampling activities/locations and observations. Field logbooks will be bound volumes with sequentially numbered pages. No pages will be removed from the logbooks for any reason. If corrections are necessary, they will be made by drawing a single line through the original entry (so that original entry can still be read) and writing the corrected entry alongside it. The correction will be initialed and dated. Information to be recorded, if appropriate, will include, but is not limited to, the following:

- Project name and number,
- Arrival and departure times,
- Personnel on site and their affiliation,
- Date and time,
- Tasks for the day,
- Weather conditions,
- Site activities,
- Site conditions and access,
- Health and safety meetings and issues,
- Names and affiliations of visitors,
- Sample location (including field sketches, if appropriate),

- Sample number,
- Sample depth,
- Sample time,
- Number of aliquots,
- Media type,
- Sampling personnel present,
- Sampling equipment used,
- PPE level, clothing, and equipment used,
- Analyses requested,
- Sample preservation,
- Associated QC samples,
- Decontamination procedures,
- Field observations,
- Photographic records,
- Other project specific information, and
- Changes or deviations to the project scope or the procedures specified in this LTMMP.

All entries will be in ink with any corrections crossed out with a single line, initialed and dated. Each page of the logbook will be signed and dated at the bottom by each individual making an entry. The logbooks will be marked with the project number and the sequential number of the logbook (i.e., Logbook #1, #2, etc.) using indelible, waterproof ink. At the completion of field activities, the logbooks will be maintained in the permanent project files.

3.10.2 Field Forms

Indelible waterproof ink will be used to record data and observations on field forms and will be maintained by sampling personnel to supplement the field logbook. Examples of the field forms to be used is provided in **Appendix B**. Copies of the sample collection field forms will be hand delivered to the PM for review and distribution at the completion of each sampling event and will be maintained in the permanent project files.

3.10.3 Daily Quality Control Reports

Field data and pertinent QA/QC information will be recorded in Daily Quality Control Reports (DQCR) during all field activities. A sample DQCR form is presented in **Appendix B**. DQCRs will be prepared, signed, and dated by the field team leader. If problems are encountered, the contractor PM will be notified by telephone and the DQCR form reported to USACE's PM.

3.10.4 Photographic Documentation

A photographic record of all sampling locations will be prepared by the field team. New photographs will be obtained during subsequent LTM events only if site conditions change or new sample locations added. Digital images will be downloaded from the digital media to the digital project files and recorded as appropriate in the field logbooks and on DQCR documentation, including identification of the subject and area photographed.

3.10.5 Project File

Project files will be maintained by the project PM and will include a minimum of the following project records. Analytical records will be available to access on the USACE Fort Devens database:

- Project plans and specifications, if any,
- Field logbooks and data records,
- Photographs, maps, and drawings,
- Sample identification documents,
- Chain of custody records (copies),
- Analytical data package from the laboratory, including QC documentation,
- Data review notes,
- References and literature,
- Report notes and calculations,
- Progress and technical reports,
- Correspondence and other pertinent information, and
- Authorizations (e.g., property access, well installation forms, etc.).

This page is intentionally left blank.

4.0 LAND-USE CONTROL IMPLEMENTATION AND MONITORING PLAN

4.1 GENERAL

LUCs are key components of the remedy selected by the site-specific ROD for AOC A7. **Table 4-1** summarizes the key components of the remedy. The LUCs include preventing the use of the site for residential purposes and restricting the use of site groundwater. The following subsections describe the methodology used to perform LUC monitoring activities.

4.2 LAND-USE CONTROL INSPECTION

Existing land use and site conditions will be assessed remotely during annual LUC interviews with site representatives and on site during LTM events to ensure that the LUC requirements are being met. If future proposed land uses are inconsistent with the LUCs, then site exposure scenarios to human health and the environment will be re-evaluated to ensure that the selected response actions are appropriate.

4.2.1 Physical On-Site Inspection

Field personnel will perform a physical inspection of AOC A7 at the Annex during the fall LTM event to determine compliance with the LUC at AOC A7. The physical inspection at AOC A7 includes the area surrounding groundwater monitoring well locations and the path or route to wells. The physical inspection of the AOC will include the following:

- Land use conditions (presence of buildings and level of recreational use);
- Evidence of any changes to site use;
- Evidence of any significant excavation or surface or subsurface soil disturbance;
- Evidence of any activities that have disrupted or otherwise negatively impacted the subsurface soil sites below the depth of 4 feet; and,
- Evidence that no harmful exposures to the public are evident regarding soil or groundwater.

Site-specific annual LUC checklists, including physical on-site inspection components, were developed for use during LUC verification activities. LUC checklists are presented in **Appendix E**.

4.3 INTERVIEW

Telephone interviews will be conducted with the property owner, manager, or other designee familiar with the day-to-day activities at AOC A7. During the interviews, the representative from the site will be asked about compliance with the existing LUCs. Specifically, the following items will be discussed during the interviews:

- The representative’s familiarity with the LUC imposed upon the property and documentation of these controls;
- Changes to site use;

- Approved conditional exemptions, amendments and/or releases;
- Unauthorized use and activities;
- Review of corrective action to resolve unauthorized uses and activities;
- Overall effectiveness of the LUC;
- The current source of public drinking water for the property; and
- Proposed plans for property sale, future redevelopment and construction or demolition activities at the site.

Site-specific annual LUC checklists, including interview components, were developed in 2007 for use during LUC verification activities. LUC checklists and interview questions for the Annex are presented in **Appendix E**. LUC interviews are performed annually with USFWS and FEMA.

5.0 REPORTING REQUIREMENTS

Requirements for LTM reporting are discussed below and additional details are provided in the QAPP (KGS, 2016). Proposed changes to the LTM activities or reporting will be presented in revisions to this LTMMP.

5.1 ANNUAL REPORTS

An Annual Report will be prepared to summarize LTM activities and results. The report will include a description of LTM activities, a summary of groundwater sampling results and an assessment of groundwater and surface water elevation data as applicable. It also will include an assessment of the potential for off-site migration of COC and annual LUC inspection results. Completed field documentation forms will be included as an appendix to the LTM report. Finally, the report will include a discussion of any corrective actions that were necessary due to changing site conditions and/or land use. The Annual Report will be submitted to the BRAC distribution list that includes USACE, USEPA, MassDEP, USFWS, BRAC Environmental Coordinator, and designated Restoration Advisory Board (RAB) members. **Table 5-1** summarizes the sampling and reporting requirements.

5.2 ANALYTICAL RECORDS

Laboratory data packages will be provided in PDF format from the analytical laboratory and will include summary forms plus all associated raw supporting data. The format deliverable should be equivalent to those specified in the latest versions of EPA Contract Laboratory Program Statements of Work for Organic Analyses or as defined in the DoD QSM version 5.2 (DoD, 2018).

The analytical data for this project site will be collected and documented in such a manner that will allow the generation of data packages that can be used to reconstruct the analytical process. The PDF sample delivery group (SDG) data packages will be loaded to the project library in the Former Fort Devens database (https://ftdevens.org).

5.2.1 Analytical Electronic Data Format

The laboratory will submit an electronic data deliverable (EDD) in a format that conforms to the Former Fort Devens database EDD specifications. The laboratory is responsible for loading the EDD directly into the Former Fort Devens database. QC checks are in place to screen the EDD; the laboratory is responsible for correcting and resubmitting the EDD until it passes the EDD QC checks. All electronic data submitted by the analytical laboratory will be error free and in complete agreement with the PDF version.

5.2.2 Analytical Data Review

LTM data will be reviewed in accordance with *DoD General Data Validation Guidelines* (EDQW, 2018), *USEPA National Functional Guidelines for Superfund Organic Methods Data Review* (USEPA, 2017), *USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA, 2017) and the QAPP (KGS, 2016). The project chemist will evaluate and apply data qualifiers following the procedure described below.

Once a laboratory EDD is successfully uploaded to the Former Fort Devens database and certified by the laboratory, an Automated Data Review (ADR) process is initiated. The ADR compares the EDD to project guidance (also called an eQAPP), which has been set up in the database based on the project QAPP criteria and DQOs. The ADR performs a Stage 2A electronic data review (USEPA data validation code "S2AVE") based on criteria specified in the eQAPP. The ADR electronically compares the loaded EDD to the eQAPP criteria listed below, summarizes QC outliers in an ADR Detail Report, and applies data validation qualifiers to associated results.

- Analytical method/preparation method
- Matrix codes
- Chain-of-custody
- Holding times
- Reporting Limits –LOQs, LODs and DLs
- Blanks –method blanks (MBs), equipment blanks (EBs), field reagent blanks (FRBs)
- LCS and MS/MSD control limits
- Field duplicate precision
- Surrogate control limits

A "first review" data validator performs a Stage 2B electronic and manual data validation (USEPA data validation code "S2BVEM") based on the initial ADR Stage 2A electronic validation (S2AVE). The Data Validator reviews the ADR Detail Report against the PDF laboratory report to verify/modify the ADR qualification of the sample results and to supplement the ADR review with a manual review of QC elements that were not included in the ADR review. The "first review" process includes the following:

- Review of the case narrative for any outstanding laboratory issues
- Verification of the ADR identified QC outliers against the PDF laboratory report
- Editing or addition of data validation qualifiers applied by the ADR after evaluation of the case narrative and sample results based on chemist's professional judgment
- Check of 10% of the sample results reported on Form 1s in the PDF laboratory report (SDG) to verify the "detected results" listed in the ADR Detail Report
- Manual review of QC elements that were not included in the ADR review such as instrument-related QC results including calibrations, internal standards, and tuning
- Completion of a project-specific data review checklist verifying that each item has been reviewed and evaluated
- Preparation of a summary data validation report which includes a "first review" markup of the ADR Detail Report and completion of the project-specific data review checklist
- Submittal of the "first review" summary data validation report to a "second reviewer"

The "second reviewer" reviews the "first review" markup of the ADR Detail Report; verifies the checklist, checks spelling and grammar; and generates the final ADR Data Validation Report, which contains the ADR summary, qualification detail and data review checklists. Once the final ADR Data Validation Report is submitted to the database library, the data are "approved" in the Former Fort Devens database. At this point, the Stage 2B electronic and manual data validation (S2BVEM) process is complete and the final validated data are available in the database for reporting.

Manual recalculation checks of raw data are not anticipated, unless the project chemist suspects that there is an issue with the laboratory data.

This page is intentionally left blank.

6.0 HEALTH AND SAFETY

Health and safety policies, procedures, and requirements are fully documented in the Accident Prevention Plan and Site Safety and Health Plan (KGS, 2018b). A designated Site Safety and Health Officer will be present at Sudbury for each LTM event and will be responsible for ensuring that all LTM activities are conducted in accordance with health and safety requirements.

A USACE weekly safety meeting form is provided in Appendix B for Annex LTM-related site visits.

This page is intentionally left blank.

7.0 REFERENCES

ABB, 1997. *Record of Decision Area of Contamination A4 and Areas of Contamination A7 and A9, Management of Migration Operable Units*, U.S. Army Sudbury Annex, Middlesex County, MA. Prepared for the U.S. Army Corps of Engineers – New England District. September.

Department of Defense (DoD), 2018. *Quality Systems Manual for Environmental Laboratories. Version 5.2.* December.

DoD Environmental Data Quality Workgroup, 2018. *General Data Validation Guidelines*. February.

HydroGeologic, Inc (HGL), 2009. *Long-Term Monitoring and Maintenance Plan, Former Sudbury Training Annex, Sudbury, Massachusetts.* March.

KOMAN Government Solutions, LLC (KGS), 2016. *2016 Five-Year Review Report for Former Sudbury Training Annex, Sudbury, Massachusetts*. September.

KGS, 2016. *Quality Assurance Project Plan (QAPP) for the Annual Long-Term Monitoring (LTM) Program, Former Fort Devens Army Installation, Devens, Massachusetts.* October.

KGS, 2018a. *Summary of Changes to the LTMMP for Area of Contamination A7, Former Sudbury Training Annex, Sudbury, Massachusetts.* October 27.

KGS, 2018b. *Accident Prevention Plan for Environmental Remediation Services, Former Fort Devens Army Installation, BRAC Legacy Sites, Massachusetts.* August.

KGS, 2018c. *2017 Annual Report, Long-Term Monitoring and Maintenance, Area of Contamination A7, Former Sudbury Training Annex, Former Fort Devens Army Installation. Devens, Massachusetts.* June.

OHM Corporation (OHM), 1995. *Record of Decision Source Control Operable Unit AOC A7, the Old Gravel Pit Landfill, AOC A9 the POL Burn Area*, Sudbury Training Annex Middlesex County, MA. Prepared for the U.S. Army Environmental Center, August 1995.

Sovereign Consulting, Inc. and HydroGeologic, Inc. (Sovereign/HGL), 2015. *Long-Term Monitoring and Maintenance Plan for Former Fort Devens Army Installation and Sudbury Training Annex, Sudbury, Massachusetts.* February.

U.S. Army Corps of Engineers (USACE), 1995. EM200-1-2, *Technical Project Planning Guidance for HTRW Data Quality Design.*

USACE, 1998. *Long Term Monitoring and Maintenance Plan for the Landfill at Area of Concern A7.* April.

USACE, 1999. *Addendum to Long Term Monitoring and Maintenance Plan for the Landfill at Area of Concern A7.*

USACE, 2001. EM200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans*. February.

U.S. Environmental Protection Agency (USEPA), 1992. *Guide to Management of Investigation-Derived Wastes*. Office of Solid Waste and Emergency Response. January.

USEPA, 2017. *USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review*. January.

USEPA, 2017. *USEPA National Functional Guidelines for Organic Superfund Methods Data Review*. January.

USEPA, New England, Region I, 2018. *EPA New England Environmental Data Review Program Guidance.* June.

USEPA, Region 1, 2017. *Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.* January.

FIGURES

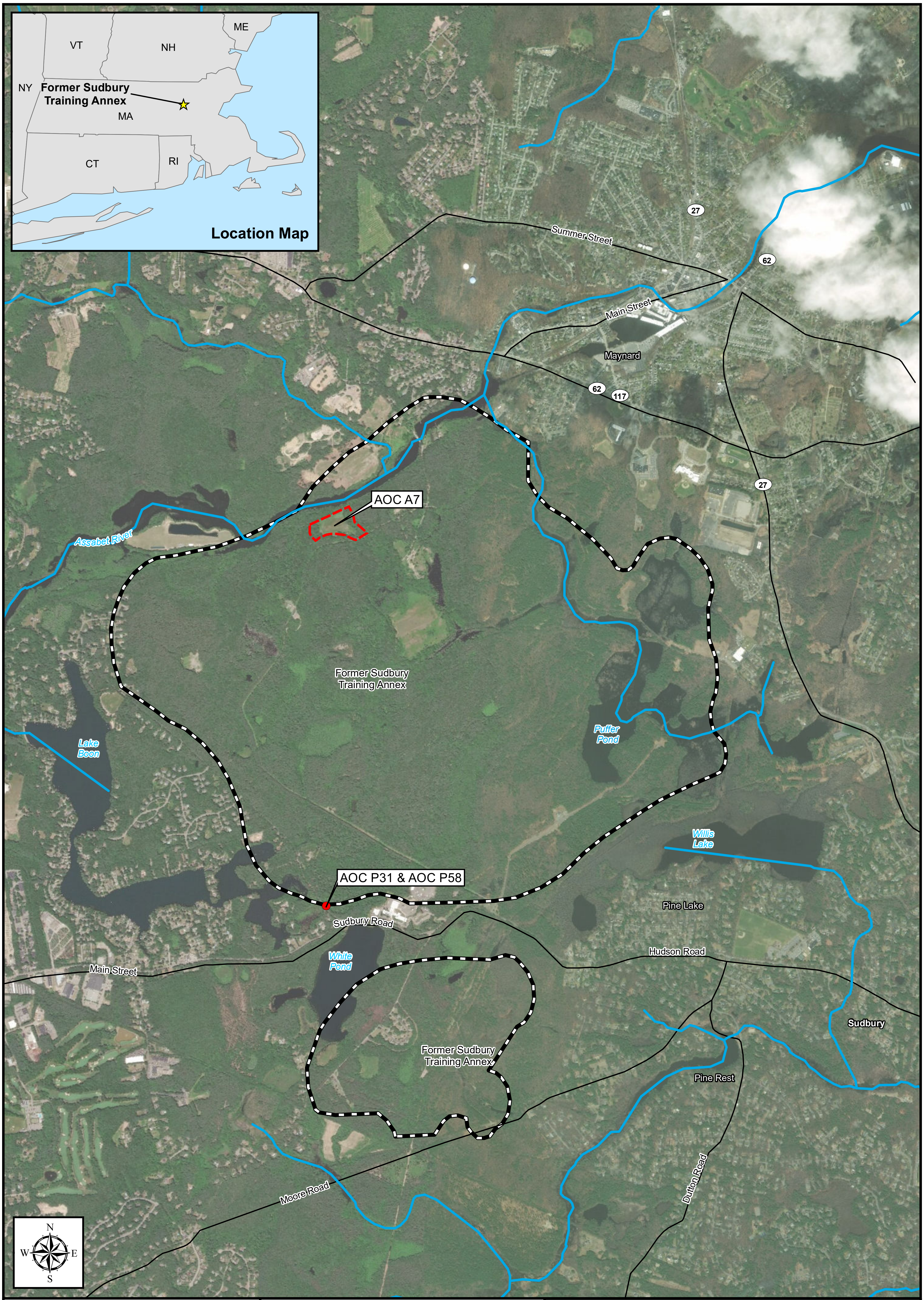


Figure 1-1
Site Location
Former Sudbury Training Annex

Aerial Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend
- Area of Contamination (AOC)
- Area of Contamination Perimeter
- Surface Water Course
- Major Road
- Former Sudbury Training Annex

2019 LongTerm Monitoring and Maintenance Plan
Former Sudbury Training Annex (AOC A7)

Former Fort Devens Army Installation
Sudbury Training Annex, Sudbury, MA

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 1,000 2,000
Feet

Date: 01/24/2019

Figure 1-1

File: SUD_2018FALL_LTM_F1-1-SiteLocation.mxd

File: SUD_2018FALL_LTM_F1-2-SiteA7.mxd

Figure 1-2
Site Layout
AOC A7

Legend

- LTM Sample Well
- LTM Well - Gauge Only
- Staff Gauge
- Monitoring Well - Damaged
- Monitoring Well - Abandoned
- Gas Vent
- OHM-A7-08 Well/Gauge/Vent Identification
- Fence
- Stump Pile Area
- Rip Rap
- Area of Contamination (AOC)
- Topographic Contour (ft AMSL)

Notes:
LTM = long term monitoring
JO-A07-M61 could not be located

Aerial Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

2019 Long-Term Monitoring and Maintenance Plan
Former Sudbury Training Annex (AOC A7)

Former Fort Devens Army Installation
Sudbury Training Annex, Sudbury, Massachusetts

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 60 120 Feet	Date: 12/12/2019	Figure 1-2	KGS

TABLES

Table 3-1
Groundwater Monitoring Locations Selected for Long-Term Monitoring at AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Monitoring Well ID	Location Description	Rationale	Total Depth (ft below TOC)	Screened Interval Depth (ft below TOC)	Top of Well Screen Elevation (ft NGVD88)	Bottom of Well Screen Elevation (ft NGVD88)	Screen Length (ft)	TOC Elevation (ft NGVD88)	Monitoring Program
OHM-A7-09	North of cap (at center) along Track Road.	LTM Water Level Only	14.9	6.9 - 14.9	178.51	170.51	8	185.41	Water Level Only
OHM-A7-10	Along Track Road, east of OHM-A7-9.	LTM Water Level Only	11.6	3.6 - 11.6	176.80	168.8	8	180.40	Water Level Only
OHM-A7-11	Adjacent to OHM-A7-10.	LTM Water Level Only	30.9	20.9 - 30.9	160.03	150.03	10	180.93	Water Level Only
OHM-A7-12	East of toe drain on eastern edge of landfill.	LTM Water Level Only	20.8	5.8 - 20.8	180.49	165.49	15	186.29	Water Level Only
OHM-A7-45	West of cap near the west drainage ditch.	LTM Water Level Only	22.2	7.2 - 22.2	202.01	187.01	15	209.21	Water Level Only
OHM-A7-46	West end of cap; well-depth was measured on 10/17/2002 as 19.55 feet below TOC.	LTM Water Level Only	19.6	13.1 - 19.6	203.97	197.47	6.5	217.07	Water Level Only
OHM-A7-51	Northern boundary along Track Road, west end.	LTM Water Level Only	22.6	7.6 - 22.6	180.82	165.82	15	188.42	Water Level Only
OHM-A7-52	Northern boundary along Track Road, west end.	LTM Water Level Only	21.7	6.7 - 21.7	180.61	165.61	15	187.31	Water Level Only
JO-A07-M61	Between fence line and Assabet River, north of OHM-A7-52.	LTM Water Level Only	6.0	1 - 6 (measured depth 5.1 ft)	179.10	174.10	5	180.10	Water Level Only
OHM-A7-08	Downgradient of former Lab Waste Area (west end of landfill cap).	Monitor for decrease in COC concentrations	35.6	20.6 - 35.6	198.44	183.44	15	219.04	Biennial (2020), VOC COCs, Pesticides, COD, CN
SUD-A07-014	Background for AOC 47; replacement for OHM-A7-13. Well is inside the A7 enclosure, at the southern side of the site.	Monitor for changes in upgradient conditions	22.01	12.0 - 22.0	213.57	203.57	10	225.57	Biennial (2020), VOC COCs, Pesticides, COD, CN
SUD-A07-065	Replacement for JO-A07-M63; 15.1 feet south of M63; between fence line and Assabet River, between JO-A07-M61 and JO-A07-M62.	Monitor for decrease in COC concentrations	10.0	4.5 - 9.5	173.32	168.32	5	177.82	Biennial (2020), VOC COCs, Pesticides, COD, CN

Table 3-1
Groundwater Monitoring Locations Selected for Long-Term Monitoring at AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Monitoring Well ID	Location Description	Rationale	Total Depth (ft below TOC)	Screened Interval Depth (ft below TOC)	Top of Well Screen Elevation (ft NGVD88)	Bottom of Well Screen Elevation (ft NGVD88)	Screen Length (ft)	TOC Elevation (ft NGVD88)	Monitoring Program
SUD-A7-19-01[3]	Approximately 10 feet northwest of JO-A07-M62.	Monitor this downgradient/ sentinel well for decrease in COC concentrations.	10.0	2 -10	179.30	171.30	8	180.79	Annual, VOC COCs, Pesticides, COD, CN
Northern Staff Gauge	Nail in tree located approximately 120 feet north of SUD-A7-19-01.	Monitor surface water elevations in Assabet River and seasonal elevation change of surface water from Assabet River dams.	NA	NA	NA	NA	NA	181.99	Water Level Only
Eastern Staff Gauge	Approximately 120 feet east of OHM-A7-12.	Monitor surface water elevations in Assabet River and seasonal elevation change of surface water from Assabet River dams.	NA	NA	NA	NA	NA	179.52	Water Level Only

Notes:

Depths and screened intervals are in feet below the tops of the PVC risers based on the November 2006 survey.

Vertical elevation datum is North American Vertical Datum (NAVD) 1988. Note: Elevations from 2018 annual report converted from National Geodetic Vertical Datum (NGVD) 1927 to NAVD 1988 by subtracting 0.8 from NGVD27.

ft = feet

TOC = top of casing

NA = not available/not applicable

1 - Elevation of nail in tree.

2 - Elevation of 180 ft mark on Eastern Staff Gauge.

NGVD = National Geodetic Vertical Datum 1929

AGS = above ground surface

BGS = below ground surface

COD = chemical oxygen demand

CN = cyanide

Pest = pesticides

VOC = volatile organic compound

TBD = to be determined

COC = contaminants of concern

3 - This well point was installed in 2019 to replace the seasonallydry well SUDWP-A07-01, which itself had previously replaced the damaged well JO-A07-M62. New replacement well and northern staff gauge were surveyed in Nov 2019. See Appendix B, 2019 Annual Report for survey report.

Table 3-2
Fall LTM Sample Analysis and Methods for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Sample Type	Location ID	Sample Analysis and Methods				Sample Collection Frequency[5]	Summary of LTMMP changes[1]
Groundwater Wells		**VOCs (8260B)**	**Pesticides (8081A)**	**COD (410.4)**	**Cyanide (9014)**		
Well	OHM-A7-08	1	1	1	1	Biennial in Fall[3]	Removal of total metals analysis; VOCs analyses to include only COPCs; reduced sampling frequency from annual to biennial based on maintained downward trend in concentrations.
Well	SUD-A07-014	1	1	1	1	Biennial in Fall[3]	Removal of total metals analysis; VOCs analyses to include only COPCs; reduced sampling frequency from annual to biennial based on no groundwater analytical exceedance at upgradient well.
Well	SUD-A07-065	1	1	1	1	Biennial in Fall[3]	Removal of total metals analysis; VOCs analyses to include only COPCs; reduced sampling frequency from annual to biennial based on maintained downward trend in concentrations.
Well	SUD-A07-19-01	1	1	1	1	Annual in Fall	Removal of total metals analysis; VOCs analyses to include only COPCs.
QC Samples							
QC	A7-Trip Blank	1	0	0	--	Per Event[4]	No changes
QC	A7-Duplicate	1	1	1	1	Annual[4]	Change in analytes as noted above. During biennial sampling events (2020, 2022, etc.), the duplicate sample will be collected from OHM-A7-08. During the alternate annual sampling events (2021, 2023, etc.), the duplicate sample will be collected from SUD-A7-19-01.
QC	A7-Matrix Spike	1	1	1	1	Annual[4]	Change in analytes as noted above. During biennial sampling events (2020, 2022, etc.), the MS sample will be collected from well SUD-A07-065. During the alternate annual sampling events (2021, 2023 etc.), the MS sample will be collected from SUD-A7-19-01. The lab will be notified of the historical contaminant concentrations in these wells so that the MS can be prepared at an appropriate level.
QC	A7-Matrix Spike Duplicate	1	1	1	1	Annual[4]	Change in analytes as noted above. During biennial sampling events (2020, 2022, etc.), the MSD sample will be collected from well SUD- A07-065. During the alternate annual sampling events (2021, 2023, etc.), the MSD sample will be collected from SUD-A7-19-01. The lab will be notified of the historical contaminant concentrations in these wells so that the MSD can be prepared at an appropriate level.

Table 3-2
Fall LTM Sample Analysis and Methods for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Sample Type	Location ID	Sample Analysis and Methods				Sample Collection Frequency[5]	Summary of LTMMP changes[1]
QC	A7-Rinsate Blank	1	1	0	1	Annual (as needed)	Change in analytes as noted above. RB sample collected as needed, if non-dedicated sampling equipment is used. During biennial sampling events (2020, 2022, etc.), the RB sample will be collected following sampling of well SUD-A07-065. During the alternate annual sampling events (2021, 2023, etc.), the RB sample will be collected following sampling of SUD-A7-19-01.
Gas Vents							
Gas Vent	A7-1 through A7-4					Every 5 years	Reduced sampling frequency to once every 5 years before the Five-Year Review. The next gas monitoring event will be in Fall 2020 in preparation for the 2021 Five-Year Review.

(1) These changes to the 2015 LTMMP were implemented in 2017, in accordance with the recommendations in the 2016 Five Year Review (Sections 6.4.2, 6.5.3, 6.7) and the 2016 Annual Report.

(2) VOC COPCs only, which includes PCE, TCE, 1,1,2,2-tetrachloroethane, cis-1,2-DCE, and trans-1,2-DCE (Section 6.7 of the 2016 Five Year Review).

(3) Biennial sampling beginning in 2020 (then 2022, etc.).

(4) The frequency of QC samples from the 2015 LTMMP has not changed: one duplicate and MS/MSD per sampling event; one RB as needed; one trip blank per cooler shipped with VOCs.

(5) There are no changes from the 2015 LTMMP regarding water level measurements (water levels from 13 wells will continue to be measured during each LTM sampling event). The fall sampling event will be conducted during the October-November timeframe.

Table 3-3
Sample Preparation, Analysis Methods, Containers, Preservatives and Holding Times for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Parameter	Analysis Method[1]	Sample Container[2]	Preservative	Holding Time
VOCs	SW8260C	3 x 40-mL vials with teflon septa screw caps	HCl to pH < 2 (no headspace); 4 ± 2°C	14 days
Pesticides	SW8081B	2 x 1-Liter amber glass	4 ± 2°C	7 days to extract; 40 days to analyze
COD	E410.4	1 x 500-mL amber glass	H_2SO_4 to pH < 2; 4 ± 2°C	28 days
Cyanide	SW9012B	1 x 250-mL HDPE	NaOH to pH > 12; 4 ± 2°C	14 days

Notes:
[1] *Methods for Chemical Analysis of Water and Wastes* , Cincinnati, OH July 2014, EPA 600-4-79-020. *Test Methods for Evaluating Solid Waste, Physical and Chemical Methods* , USEPA SW-846, 5th Edition.
[2] Additional sample containers/volume are required for matrix quality control samples.
VOCs - volatile organic compounds
COD - Chemical Oxygen Demand

Table 3-4
Action Levels for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Chemical of Concern	MCP GW-1 (µg/L)	MCP GW-3 (µg/L)	MMCL[1] (µg/L)	MCL[2] (µg/L)	Action Level (µg/L)
VOCs					
1,1,1,2-Tetrachloroethane	5	50,000	NS	NS	5
1,1,1-Trichloroethane	200	20,000	5	200	5
1,1,2,2-Tetrachloroethane	2	50,000	NS	NS	2
1,1,2-Trichloroethane	5	50,000	NS	NS	5
1,1-Dichloroethane	70	20,000	NS	NS	70
1,1-Dichloroethene	7	30,000	NS	NS	7
1,1-Dichloropropene	NS	NS	NS	NS	NS
1,2,3-Trichlorobenzene	NS	NS	NS	NS	NS
1,2,3-Trichloropropane	NS	NS	NS	NS	NS
1,2,4-Trichlorobenzene	70	50,000	NS	NS	70
1,2,4-Trimethylbenzene	NS	NS	NS	NS	NS
1,2-Dibromo-3-chloropropane (DBCP)	NS	NS	NS	NS	NS
1,2-Dibromoethane (EDB)	0.02	50,000	NS	NS	0.02
1,2-Dichlorobenzene	600	2,000	NS	NS	600
1,2-Dichloroethane	5	20,000	NS	NS	5
1,2-Dichloropropane	5	20,000	NS	NS	5
1,3,5-Trimethylbenzene	NS	NS	NS	NS	NS
1,3-Dichlorobenzene	100	50,000	NS	NS	40
1,3-Dichloropropane	0.4	10	NS	NS	0.4
1,4-Dichlorobenzene	5	8,000	NS	NS	5
2,2-Dichloropropane	NS	NS	NS	NS	NS
2-Butanone	4,000	50,000	NS	NS	4,000
2-Chlorotoluene	NS	NS	NS	NS	NS
2-Hexanone	NS	NS	NS	NS	NS
4-Chlorotoluene	NS	NS	NS	NS	NS
4-Isopropyltoluene	NS	NS	NS	NS	NS
4-Methyl-2-Pentanone (MIBK)	350	50,000	NS	NS	350
Acetone	6,300	50,000	NS	NS	6,300
Benzene	5	10,000	NS	NS	5
Bromobenzene	NS	NS	NS	NS	NS
Bromochloromethane	NS	NS	NS	NS	NS
Bromodichloromethane	3	50,000	NS	NS	3
Bromoform	4	50,000	NS	NS	4
Bromomethane	10	800	NS	NS	10
Carbon Disulfide	NS	NS	NS	NS	NS
Carbon Tetrachloride	5	5,000	NS	NS	5
Chlorobenzene	100	1,000	NS	NS	100
Chloroethane	NS	NS	NS	NS	NS
Chloroform	70	20,000	NS	NS	70
Chloromethane	NS	NS	NS	NS	NS
cis-1,2-Dichloroethene	70	50,000	NS	NS	70
cis-1,3-Dichloropropene	0.4	200	0.4	NS	0.4
Dibromochloromethane	2	50,000	NS	NS	2
Dibromomethane	NS	NS	NS	NS	NS
Dichlorodifluoromethane (Freon 12)	NS	NS	NS	NS	NS
Ethylbenzene	700	5,000	NS	NS	700
Hexachlorobutadiene	0.6	3,000	NS	NS	0.6
Isopropylbenzene	NS	NS	NS	NS	NS
m-Xylene & p-Xylene	10,000	5,000	NS	NS	10,000
Methyl tert-Butyl Ether	70	50,000	NS	NS	70
Methylene Chloride	5	50,000	NS	NS	5
Naphthalene	140	20,000	NS	NS	140
n-Butylbenzene	NS	NS	NS	NS	NS
n-Propylbenzene	NS	NS	NS	NS	NS
o-Xylene	10,000	5,000	NS	NS	5,000
sec-Butylbenzene	NS	NS	NS	NS	NS
Styrene	100	6,000	NS	NS	100
tert-Butylbenzene	NS	NS	NS	NS	NS
Tetrachloroethene	5	30,000	5	5	5
Toluene	1,000	40,000	1,000	1,000	1,000
trans-1,2-Dichloroethene	100	50,000	NS	NS	100
trans-1,3-Dichloropropene	0.4	200	NS	NS	0.4
Trichloroethene	5	5,000	5	5	5
Trichlorofluoromethane (Freon 11)	NS	NS			
Vinyl Chloride (chloroethene)	2	50,000	2	2	2
PESTICIDES					
4,4'-DDD	0.2	50	NS	NS	0.2
4,4'-DDE	0.05	400	NS	NS	0.05
4,4'-DDT	0.3	1	NS	NS	0.3
Aldrin	0.5	20	NS	NS	0.5
alpha-BHC	500	NS	NS	NS	500

Table 3-4
Action Levels for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Chemical of Concern	MCP GW-1 (μg/L)	MCP GW-3 (μg/L)	MMCL[1] (μg/L)	MCL[2] (μg/L)	Action Level (μg/L)
alpha-Chlordane	2	2	2	NS	2
beta-BHC	100	NS	NS	NS	100
delta-BHC	100	NS	NS	NS	100
Dieldrin	0.1	1	NS	NS	0.1
Endosulfan I	0.1	NS	NS	NS	10
Endosulfan II	10	2	NS	NS	0.1
Endosulfan sulfate	0.1	NS	NS	NS	0.1
Endrin	2	5	2	2	2
Endrin aldehyde	100	NS	NS	NS	100
Endrin ketone	100	NS	NS	NS	100
Gamma-BHC(1,2,3,4,5,6-hexachlorocyclohexane, gamma isomer or Lindane)	0.2	4	0.2	0.2	0.2
gamma-Chlordane	2	NS	NS	2	2
Heptachlor	0.4	1	0.4	0.4	0.4
Heptachlor epoxide	0.2	2	0.2	0.2	0.2
Methoxychlor	40	10	40	40	40
Total Chlordane	2	2	2	2	2
Toxaphene	100	NS	2	3	100
CYANIDE					
Cyanide, total	200	30	200	200	200
Chemical Oxygen Demand	NS	NS	NS	NS	NS

Notes:

[1] "Massachusetts Drinking Water Standards & Guidelines", Winter 2020, MassDEP.

[2] "2018 Edition of Drinking Water Regulations and Health Advisories", March 2018, USEPA Office of Water.

NA = Not applicable.

NS = No standard.

MCL = Maximum Contaminant Level (USEPA)

MCP = Massachusetts Contingency Plan (MassDEP)

MMCL = Massachusetts Maximum Contaminant Level.

GW-1 = Concentrations based on use of groundwater as drinking water, either currently or future.

GW-3 = Conentrations based on the potential environmental effects resulting from contaminated groundwater discharging to surface water.

Regional Screening Levels (RSLs) Resident Tapwater Table (November 2019) for specific COCs include:

1,1,2,2-Tetrachloroethane, 7.6E-02 ug/L (0.076 ppb) at 1E-06

Tetrachloroethene, 1.1E+01 ug/L (11 ppb) at 1E-06

Trichloroethene, 4.9E-01 ug/L (0.49 ppb) at 1E-06

Gamma BHC (Lindane), 4.2E-02 (0.042 ppb) at 1E-06

Table 3-5
Sample and Analytical Summary for IDW Characterization and Disposal
Former Sudbury Training Annex
Sudbury, Massachusetts

Sample Type/Matrix	Analytical Parameter (Method Number)	Number of Field Samples	Field QC Samples				Holding Times	Preservation Requirements	Sample Containers (per sample)	Total Sample Containers
			Duplicates	Equipment Rinsate	MS/ MSD	Trip Blanks				
Decontamination and well purge water to be stored in 55-gallon drums or other approved containers	RCRA VOCs (SW8260B)	1	0	0	0	0	14 Days	Ice to 4 °C, HCl	Two 40-ml GSV	3
	RCRA SVOCs (SW8270C)	1	0	0	0	0	7 Days	Ice to 4 °C	One 1-L Amber Glass	1
	RCRA Metals (SW6010B)	1	0	0	0	0	6 Months	Ice to 4 °C, HNO_3	One 1-L Poly	1
	RCRA Pesticides (SW8081A)	1	0	0	0	0	14 Days	Ice to 4 °C	Two 1-L Amber Glass	2
	RCRA Herbicides (SW8151A)	1	0	0	0	0	7 Days	Ice to 4 °C, $Na_2S_2O_3$	Two 1-L Amber Glass	2

Notes:
°C = Degree Celsius
GSV = Glass Septum Vial
HCl = Hydrochloric Acid
L = Liter
ml = Milliliter
HNO_3 = Nitric Acid
MS = Matrix Spike
oz = Ounce
Poly = Polyethylene Bottle
RCRA = Resource Conservation and Recovery Act
QC = Quality Control
VOC = Volatile Organic Compound
SVOC = Semi-volatile Organic Compound
MSD = Matrix Spike Duplicate

Table 4-1
ROD Objectives for AOC A7
Former Sudbury Training Annex
Sudbury, Massachusetts

Site	Site specific ROD objective LUC	Site specific implementation elements per LTMMP to meet ROD objective elements	Documents used to implement/monitor/ enforce LUC
AOC A7	Prohibit the use of site groundwater as drinking water at AOC A7.	I Site Information II Documentation & Records III Physical On-site Inspection IV Interview V Response Actions	ROD 1995; Memorandum of Agreement (MOA) between the Army and the USFWS dated 28 September 2000

Notes:
* AOC A7 has annual reporting and five-year site reviews.

Table 5-1
Summary of Sampling and Reporting Requirements
Former Sudbury Training Annex
Sudbury, Massachusetts

Report/Sample	Frequency Fall (October/November)
Sudbury Landfill, AOC A7	
Groundwater Sampling	Includes annual and biennial wells
Groundwater Analytical Data to USEPA	Within 60 Days of Sampling
Site Inspection	Annual
Landfill Gas Monitoring	Every 5 Years
Annual Data Report to USEPA	Annual
Annual Institutional Control Interview	Annual
Site Review	Every 5 Years

APPENDIX A
LANDTEC GEM 500 CALIBRATION

Appendix A – Landtec GEM-500 Calibration Procedures

GEM-500 Easy Steps

The following steps assume the use of DataField CS 3.0 or greater.

Steps to Clear Memory from Instrument (GEM-500)

1. Turn on GEM-500
2. Press 0 to go to Main Menu
3. Press 1 General Utilities
4. Press 9 More
5. Press 4 Memory
6. To Clear Readings Press 1
7. If you wish to proceed, Enter 0102
8. Press 0 Exit to Clear
9. If you wish to Clear ID Info, Press 2
10. If you wish to proceed, Enter 0102
11. Press 0 Exit to Clear
12. Press 0 to Exit

Create New IDs

1. Start DataField 3.0 CS software
2. Plug in instrument, turn on instrument and choose option 4 Download Data when instructed to by the software.
3. Once communication is established a screen layout will be created specifically for the GEM-500.
4. Click on the ID button
5. Enter ID
   1. Info/Desc
   2. Pipe Diameter
   3. Flow Device
6. Click "SAVE" and save the file with a project name
7. Click "SEND TO INSTRUMENT"

Steps to Calibrate Methane CH_4

It's important to field calibrate the GEM-500 on-site after the instrument has stabilized at working temperature.

1. Turn Instrument GEM-500 On.
2. Press 0 to go to Main Menu
3. Press 1 General Utilities
4. Press 9 More
5. Press 6 Calibration
6. Press 1 CH_4, from Calibrate Gas Type Menu
7. Press 1 to Zero CH_4 Methane
8. Connect the tubing from the Calibration Gas Regulator / Flow Meter to the GEM-500 Gas Sample Port
   1. Note: If not using LANDTEC's supplied regulator, check the Calibration Gas Flow at 500cc and Pressure no greater than 2psig

Turn On the Gas Mixture 0_2

1. Press 5 to turn pump On
2. Once the readings have stabilized (1 Minute Approximately)...
3. Press 1 Zero Level

4. Turn Off 0_2 Gas Valve, and Disconnect from GEM-500 Port
5. Press 5 again to turn Pump Off
6. Press 0 Exit to return to the Methane Calibration Screen
7. Press 2 Calibrate CH_4 Span
8. Connect the Tubing from the Calibration Gas Regulator / Flow Meter to the GEM-500 Gas Sample Port
    1. Note: If Not using LANDTEC's supplied regulator, check the Calibration Gas Flow at 500cc and Pressure no greater than 2psig
9. Turn On the Calibration Gas Mixture of CH_4/CO_2.
10. Press 5 Turn On Pump
11. Allow Readings to Stabilize (1 Minute Approximately)
12. Press 1 Enter Gas Con
13. Enter the Gas Concentration as indicated on your CH_4 / CO_2 Nitrogen Gas Cylinder
14. Press 0 to Exit
15. Press 1 Yes
16. If Calibration OK accepted, then Turn Off Calibration Gas Cylinder
17. Remove Gas Hose attached to Gas Sample Port
18. Keep Pump running to purge Instrument (1 minute Approximately).
19. Press 5 for Pump Off
20. Press 0 to Exit

Steps to Calibrate Oxygen O_2

1. Press 3 O_2 from Calibrate Gas Type Menu
2. Press 1 Zero 0_2
3. Connect the Tubing from the Calibration Gas Regulator / Flow Meter to the GEM-500 Gas Sample Port
    1. Note: If not using LANDTEC's Regulator, Gas Flow should be 500cc and Pressure 2psig
4. Turn On the Calibration Gas Mixture of CH_4/CO_2
5. Press 5 Turn On Pump
6. Once the readings have stabilized (1 Minute Approximately)
7. Press 1 Zero Level
8. Keep Pump running for 60 Seconds to Purge Instrument
9. Press 5 Pump Off
10. Press 0 to Exit
11. Press 2 Calibrate O_2 Span
12. Change the Calibration Gas Mixture to Oxygen/Nitrogen and Connect it to the GEM-500 Sample Port
    1. Note: If not using LANDTEC's Regulator, Gas Flow should be 500cc and Pressure 2psig
13. Turn On the Calibration Gas Mixture O_2/Nitrogen
14. Press 5 Pump On
15. Allow O_2 readings to stabilize
16. Press 1 Enter Gas Con
17. Enter Gas Concentration as indicated on your Oxygen / Nitrogen Gas Cylinder
18. Press 0 to Exit
19. Press 1 Yes
20. Turn Off Calibration Gas
21. Disconnect 0_2/Nitrogen Gas Cylinder from GEM-500 Port
22. Press 5 Pump Off
23. Press 0 to Exit

Steps to Perform Readings

1. Turn On Instrument

2. Press 0 to go to Main Menu
3. Press 2 Read Gas Levels
4. Press 1 Read using ID?
5. Press 1 (If you want to Scroll)
6. Press 2 (If you want to Enter Manually)
7. (If you Scroll), Press UP or Down Arrows and #2 to Select
8. Press 1 to Read
9. Press 5 Pump On
10. Allow Readings on left side of the screen to become stable
11. Press 5 Pump Off
12. To record Temperature and Probe Depth, Press 2 More
13. Press 1 to Enter Temperature
14. After Entering Temperature, Press 0 to Exit
15. Press 3 to Zero Pressure
    1. Note: Disconnect hose before zeroing, Then Press any key
16. Press 1 to Zero Pressures
17. Press 0 to Exit
    1. Note: Reconnect hose. Allow the Instrument to read
18. Press 2 Continue
19. If the Flow needs to be changed adjust the control valve on the Well head.
20. Press 6 to Store
21. Press 1 or 6 to scroll Up or Down Comments
22. To select a Comment, Press 2
23. Press 0 to Store
24. If you want to go to Next ID then,
25. Press 4 to go to Next ID
26. Press 2 to Purge
    1. Note: Warning: Disconnect Hose from the Well
27. Press 1 to Begin Purging
28. Press 0 to Back
29. Press 0 to Exit Purge
30. Press 1 for Next ID
31. Begin Reading Process Again!

Steps to Download Readings to Datafield

1. Start DataField 3.0CS software
2. Plug in instrument, turn on instrument and choose option 4 Download Data when instructed to by the software.
3. Once communication is established a screen layout will be created specifically for the GEM-500 instrument.
4. Click on the readings button
5. Click on the button labeled "Load From Instrument"
6. The readings will be transferred from the GEM to the computer.
7. Click on the Save File button to save the readings from Datafield 3.0CS to a file.
    1. Hint: be sure to end the file name with a .CSV (this will assist with opening the file in Excel)

APPENDIX B
FIELD FORMS

Turbidity Instrument Calibration Log

Project/Site Name: ______________________________ **Instrument:** ______________________

Calibrated By: ______________________________ **Serial Number:** ______________________

	AM Calibration				PM Post Calibration Check		
Date	Pre-Cal 0 NTU	Post-Cal 0 NTU	Pre-Cal 10 NTU	Post-Cal 10 NTU	0 NTU	10 NTU	Variance Noted
					Post Calibration Criteria		
					-	± 0.5	

Notes: Mark Noted Variences on Field Forms

Signature: ______________________ **Date:** ______________________

KGS

Field Instrument Calibration Log

Date: ______________________________ **Weather:** ______________________________

Project/Site Name: ______________________________ **Instrument:** ______________________________

Calibrated By: ______________________________ **Serial Number:** ______________________________

Parameters	**Solution Expiration Date**	**AM Calibration Time ________**		**Cal. Temp. (°C)**	**PM Post Cal. Check Time ________**	**Post Cal. Check Temp (°C)**	**Post Cal. Check Criteria**	**Varience Noted (Y/N)**
Specific Conductivity (1413 μS/cm^{c})							±10 μS/cm	
pH (7)							± 0.3 Ph *	
pH (4)							± 0.3 Ph *	
pH (10)							± 0.3 Ph *	
ORP (240 mv)							±10 mv	
Dissolved Oxygen (%)							-	
Dissolved Oxygen (mg/L)							± 0.5 mg/L < 0.5 mg/L for 0 mg/L solution, no negative value	
Barometric Pressure (mmHg)							-	

Notes:

*** Ph Unit with Ph 7 Buffer**

(Mark Noted Variences on Field Forms)

Signature: ______________________________ **Date:** ______________________________

KOMAN GOVERNMENT SOLUTIONS LLC
Daily Field Log

Date and Time:	
Project Name:	
Project Number:	
Site Personnel:	
Tasks for Day:	
Weather/Temperature:	
Health and Safety Meeting:	
Sample Location:	
Sample ID:	
Sample Depth(s) ft bgs:	
Bottleware:	
Media Type:	
Air Monitoring:	
Sample Personnel:	
Sample Equipment:	
PPE Level:	
Sample Analyses:	
QC Samples (circle):	
Decontamination	
Field Observations	
Photo Documentation:	
Daily COC(s):	
Courier Pickup:	
Deviations or Changes from FSP:	

Signature

Date

US Army Corps of Engineers
New England District

Landfill Gas
Monitoring Table 2

INSPECTOR: ____________________ TITLE:____________ DATE:________________

ORGANIZATION: ________________ WEATHER:_____________________________

BAROMETER (in-Hg): _______TIME:__________BAROMETER _________TIME:______

Vent No.	**VOC ppm** Multi RAE+	**H_2S ppm** Multi RAE+	**LEL %** Multi RAE+	**CO ppm** Multi RAE+	**O_2 %** Multi RAE+	**O_2 %** GEM 2000	**CO_2 %** GEM 2000	**CH_4 %** GEM 2000	**LEL %** GEM 2000	**Remarks**
V-1										
V-2										
V-3										
V-4										
Pre-ambient air										
Post-ambient air										

NA – Not Analyzed

CALIBRATION INFORMATION:
Instrument: MultiRAE+
Calibrated by: US Environmental
Calibrated With: 50 ppm CO, 10 ppm H_2S, 50% LEL (CH_4), 20.9% O2, VOC 100 ppm isobutylene (R.F. = 1.0)

Instrument: Landtec GEM 2000
Calibrated by: US Environmental Rental Co.
Calibrated With: 15% CH_4, 15% CO_2, 20.9% O_2

KOMAN GOVERNMENT SOLUTIONS LLC

Low Flow/ Low Stress Groundwater Sampling Log

KGS

Well Identification: ______________________

Project: ______________________ Date: ______________

Location: ______________________ Sampler: ______________

Well Integrity

	Yes	No	N/A
Casing Secure			
Concrete Pad intact			
PVC casing intact			
Well gripper present			
Bolts present			
Locked (stickup wells)			

Well Information

Diameter	
Material	
Depth to water (ft BTOR)	
Depth to bottom (ft BTOR)	
Pump Set Depth (ft BTOR)	
Screen Interval (ft BTOR)	
Total volume purged (gal)	

Sampling Type

Purging Method ________ Tubing type ________ Dedicated pump (Y/N) ________

Purge start/stop time ________ Tubing diameter ________ Air source ________

Field Instrument (Model/S/N) ______________________

Stabilization Parameters

Time (hhmm)	Flow Rate (ml/min)	Depth to Water (ft)	Temp (ºC)	pH (STD)	SPC (μS/cm^c)	DO (mg/L)	ORP (mv)	Turbidity (NTU)	Color/Clarity
Acceptance Criteria:		**<0.3ft**	**±3%**	**±0.1**	**±3%**	**±10%**	**± 10mv**	**10%**	2" Screen Volume =
Post Cal. Check Varience Observed (Y/N):									0.163 gal/ft or 616 ml/ft

Sampling Details

Sampling ID: ______________________

Sample Time: ________ Duplicate (Y/N): ________ MS/MSD (Y/N): ________

Field Filtered (Y/N): ________ Dup ID: ________

Filter Size: ________ Dup Time: ________

Comments ____

Signature **Date**

MONITORING WELL DEVELOPMENT RECORD

SITE:		WELL IDENTIFICATION NO.		SCREEN LENGTH (FT):	
SITE ADDRESS:		DATE INSTALLED:		CASING ID (IN):	
PROJECT NAME:		DATE DEVELOPED:		DEPTH TO BOTTOM (FT):	
PROJECT NUMBER:		DEVELOPMENT METHOD:		STATIC WATER LEVEL BEFORE (FT).	
PERSONNEL:		PUMP TYPE:		STATIC WATER LEVEL AFTER (FT).	
COMPANY:					

TIME	ESTIMATED SEDIMENT THICKNESS (IN.) Measured from TOC before/during/after	CUMULATIVE WATER VOLUME (GALS).	WATER LEVEL READINGS (FT. BELOW TOC)	TURBIDITY (NTU)	TEMP (C°)	SP. COND. (UNITS)	DO (mg/L)	pH	ORP (mV)	REMARKS (odor, color, clarity, particulate matter)
	Initial DTB **Post DTB**									

SAFETY INSPECTION REPORT

Date / Day:

Project Name:

Project Location:

Work Description:

Comments:

OBSERVATIONS

Safety Conditions Requiring Corrective Action	Corrective Action, Assignment, and Completion Date

Project Manager:

Safety Inspector:

Distribution:

KGS

CHAIN-OF-CUSTODY RECORD

KOMAN Government Services, LLC
Laurie Ekes
293 Boston Post Road West, Suite 100, Marlborough, MA 01752
(508) 366.7442, add extension lekes@komangs.com

COC #

KGS

Project: Long Term Monitoring	**Laboratory:** TestAmerica Laboratories, Inc.
Project Number: DEVNS-LTM	**Point of Contact:** Jerry Lanier ((912) 354-7858
WBS Code: Purchase Order 18-706	**Ship to:**

Analytical Test Method

Comments:

Equipment:

KOMAN, Long Term Monitoring, Sudbury Fall 2019

	Sample ID	Matrix	Date	Time	Samp Init.	VOC/ SW8260 3-40 ml (HCL)	Pesticides/ SW8081 2-1 liter amber glass	COD/SW9060 1-500 ml amber glass (H2SO4)	Cyanide/SW9012 1-250 ml poly (NaOH)							Location ID	Sample Type	Depth (ft bgs) Top	Bottom
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
Cooler:		**Turn Around Time:**																	

Relinquished by: ***(Signature)***	**Date**	**Time**	**Received by:** ***(Signature)***	**Date**	**Time**

Shipping Date / Carrier / Airbill Number

Received by Laboratory: *(Signature, Date, Time)* **& condition**

Groundwater Level Measurement Form	KGS
Project Name:	**Date:**
Location:	**Weather:**
Water Level Meter:	**Field Crew:**

Well ID	Time	Depth to Water (feet below TOC)	Total Well Depth (feet below TOC)	Notes

Comments:

TAILGATE SAFETY MEETING RECORD

Date / Day:	**Time:**
Project Name:	**Project No.:**
Client:	**Location:**
Specific Location:	
Work Description:	
Comments:	

SAFETY TOPICS PRESENTED

Protective Clothing / Equipment: Hard Hats, Personal Floatation Devices (while over water), Safety Shoes, Long Pants, Sleeved Shirts. Safety Glasses and Hearing Protection when required.

Chemical Hazards: Hydraulic Fluids, Oil, Grease, Gasoline, Diesel Fuel

Physical Hazards: Heavy Equipment Operations (Crane), Heavy Loads, Small Tool Operations, Overhead Power Lines (electrical), Water Hazards (Use PFDs, Watch for Boat Traffic), Slips, Trips, & Falls (Keep Good Housekeeping).

Emergency Procedures:

Emergency Hospital:

Hospital Telephone:

Hospital Directions:

Special Equipment: Fire Extinguishers / First Aid Kits / Spill Kits

Other:
Safety Topic:

SAFETY MEETING ATTENDEES

Name Printed / Initial	Name Printed / Initial
1.	6.
2.	7.
3.	8.
4.	9.
5.	10.

Meeting conducted by (print name / signature):

KOMAN Government Solutions, LLC
Vertical Groundwater Profiling Log

Project:	Boring No.:	Date:
Project No.:	Drilling Co.:	
Address:	Driller:	Depth to Water:
Logger:	Drilling Method:	Pump type:
Total Boring Depth:	Drilling Equip:	Tubing:
Turbidimeter (model/serial number):	YSI (model/serial number):	

Sample Interval (ft bgs)	Minimum Purge Volume	Total Volume Purged	Temp (ºC)	pH (STD)	SPC (µS/cm^c)	DO (mg/L)	ORP (mv)	Turbidity (NTU)	Sample Time	Sample Identifier	Remarks

SP16 casing purge volume = 0.0159 gal/ft or 60.3 ml per foot SP22 casing purge volume = 0.0918 gal/ft or 347.5 ml per foot

Notes:

KOMAN Government Solutions, LLC
293 Boston Post Road, Marlborough, MA

Monitoring Well Evaluation Form

Project Name:	**Date:**
Location:	**Time:**
Tidally Influenced (yes/no):	**Field Crew:**

Field Measurements

Well ID	PID Reading (PPM)	Depth to Water (feet)	Total Well Depth (feet)	Comments

Well Construction Details

Total Depth (ft)	Ground Elevation (NVGD88)	Screened Interval

Checklist

Well Material and Diameter:	
Well Casing Reference Point:	
Well ID Tag Present?	
Well Secured?	
Photo Taken?	

Well Condition

Protective Cover:	
Well Riser Casing:	
Well Pad:	
Other (Posts, Tags, Paint, etc.):	
Standing Water Around Well?	
Dedicated Equipment Present?	
Sediment in Well:	

WEEKLY SAFETY MEETING

Date Held: ________________________
Time: ____________________________

CONTRACTOR: _________________________ Contract No. DACW33-
PERSONNEL PRESENT (check): Contractor ____ Sub. ____ Government ____

SUBJECTS DISCUSSED (check items that were discussed during meeting):

USACE EM385-1-1 ______ (Specific sections: ___________________________)
On-site Accident Prevention Plan (or Site Safety and Health Plan) ______
Individual protective equipment (steel-toed boots, safety glasses, etc..) _____
Prevention of slips/falls _____
Back injury/safe lifting techniques _____
Fire prevention _____
First aid _____
Tripping hazards _____
Equipment inspection and maintenance _____
Hoisting equipment, winch and crane safety _____
Ropes, hooks, chains, and slings _____
Water safety _____
Boat safety _____
HAZMAT, Toxic hazards, contaminated sediments, MSDS, respiratory, ventilation _____
Biological hazards (poison ivy, ticks, wasps, mosquitoes etc) ______
Staging, ladders, concrete forms, safety nets, handrails ____
Hand tools, power tools, machinery, chain saws _____
Vehicle operation safety _____
Electrical grounding, temporary wiring, GFCI _____
Lockouts/safe clearance procedures _____
Welding, cutting _____
Excavation hazards/rescue _____
Loose rock/steep slopes _____
Explosives _____
Sanitation and waste disposal _____
Clean-up, trash _____

Other safety issues of concern specific to contract that was discussed during meeting:

All persons attending meeting the meeting must sign below or on the back of the form.

Contractor Representative Signature ____________________________ Date: _______
CE Inspector/QA (if present at meeting) __________________________ Date: __________

KGS

APPENDIX C
GROUNDWATER SAMPLING CHECKLIST

GROUNDWATER WELL SAMPLING CHECKLIST

SAMPLING PROCEDURE	COMPLETED?
PRE-SAMPLING	
PROPERTY OWNER CONTACTED	
LABORATORY CONTACTED 2 WEEKS PRIOR TO SAMPLING	
LABORATORY SAMPLE KIT, COOLER RECEIVED	
EQUIPMENT OBTAINED	
KEYS TO WELL LOCKS OBTAINED	
SAMPLING (EACH WELL)	
HEADSPACE READINGS COLLECTED	
DEPTH TO GROUNDWATER LEVEL COLLECTED (ALL WELLS MEASURED SAME DAY)	
WELLS PURGED	
SAMPLES COLLECTED	
DUPLICATE SAMPLE COLLECTED (MOST CONTAMINATED WELL)	
EQUIPMENT BLANK SAMPLE COLLECTED (ONE ONLY; AFTER SAMPLING A CONTAMINATED WELL)	
LABELS COMPLETED	
CHAIN OF CUSTODY COMPLETED	
CHAIN OF CUSTODY SEAL PLACED ON COOLER	
SAMPLES DELIVERED OR SHIPPED TO LABORATORY WITHIN 24 HOURS OF SAMPLE COLLECTION	
REPORT RECEIVED FROM LABORATORY	
LABORATORY REPORT FORWARDED TO USEPA AND MADEP WITHIN 60 DAYS OF SAMPLE DELIVERY/SHIPMENT	

Notes:
USEPA = United States Environmental Protection Agency
MADEP = Massachusetts Department of Environmental Protection

APPENDIX D

USEPA REGION I LOW STRESS PURGING AND SAMPLING PROCEDURES

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I

LOW STRESS (low flow) PURGING AND SAMPLING PROCEDURE FOR THE COLLECTION OF GROUNDWATER SAMPLES FROM MONITORING WELLS

Quality Assurance Unit
U.S. Environmental Protection Agency – Region 1
11 Technology Drive
North Chelmsford, MA 01863

The controlled version of this document is the electronic version viewed on-line only. If this is a printed copy of the document, it is an uncontrolled version and may or may not be the version currently in use.

This document contains direction developed solely to provide guidance to U.S. Environmental Protection Agency (EPA) personnel. EPA retains the discretion to adopt approaches that differ from these procedures on a case-by-case basis. The procedures set forth do not create any rights, substantive or procedural, enforceable at law by party to litigation with EPA or the United States.

Prepared by:__________________________________ ____________
(Robert Reinhart, Quality Assurance Unit) Date

Approved by:__________________________________ ____________
(John Smaldone, Quality Assurance Unit) Date

Revision Page

Date	Rev #	Summary of changes	Sections
7/30/96	1	Finalized	
01/19/10	2	Updated	All sections
3/23/17	3	Updated	All sections
9/20/17	4	Updated	Section 7.0

Table of Contents

1.0 USE OF TERMS

Equipment blank: The equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank needs only to include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Field duplicates: Field duplicates are collected to determine precision of the sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

Indicator field parameters: This SOP uses field measurements of turbidity, dissolved oxygen, specific conductance, temperature, pH, and oxidation/reduction potential (ORP) as indicators of when purging operations are sufficient and sample collection may begin.

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program. Consult the laboratory for the sample volume to be collected.

Potentiometric Surface: The level to which water rises in a tightly cased well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

QAPP: Quality Assurance Project Plan

SAP: Sampling and Analysis Plan

SOP: Standard operating procedure

Stabilization: A condition that is achieved when all indicator field parameter measurements are sufficiently stable (as described in the “Monitoring Indicator Field Parameters” section) to allow sample collection to begin.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site and returned to the laboratory. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

2.0 SCOPE & APPLICATION

The goal of this groundwater sampling procedure is to collect water samples that reflect the total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions, with minimal physical and chemical alterations from sampling operations. This standard operating procedure (SOP) for collecting groundwater samples will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

The SOP emphasizes the need to minimize hydraulic stress at the well-aquifer interface by maintaining low water-level drawdowns, and by using low pumping rates during purging and sampling operations. Indicator field parameters (e.g., dissolved oxygen, pH, etc.) are monitored during purging in order to determine when sample collection may begin. Samples properly collected using this SOP are suitable for analysis of groundwater contaminants (volatile and semi-volatile organic analytes, dissolved gases, pesticides, PCBs, metals and other inorganics), or naturally occurring analytes. This SOP is based on Puls, and Barcelona (1996).

This procedure is designed for monitoring wells with an inside diameter (1.5-inches or greater) that can accommodate a positive lift pump with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval"). This SOP is not applicable to other well-sampling conditions.

While the use of dedicated sampling equipment is not mandatory, dedicated pumps and tubing can reduce sampling costs significantly by streamlining sampling activities and thereby reducing the overall field costs.

The goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help to minimize sampling variability.

This procedure describes a general framework for groundwater sampling. Other site specific information (hydrogeological context, conceptual site model (CSM), DQOs, etc.) coupled with systematic planning must be added to the procedure in order to develop an appropriate site specific SAP/QAPP. In addition, the site specific SAP/QAPP must identify the specific equipment that will be used to collect the groundwater samples.

This procedure does not address the collection of water or free product samples from wells containing free phase LNAPLs and/or DNAPLs (light or dense non-aqueous phase liquids). For this type of situation, the reader may wish to check: Cohen, and Mercer (1993) or other pertinent documents.

This SOP is to be used when collecting groundwater samples from monitoring wells at all Superfund, Federal Facility and RCRA sites in Region 1 under the conditions described herein. Request for modification of this SOP, in order to better address specific situations at individual wells, must include adequate technical justification for proposed changes. <u>All changes and modifications must be approved and included in a revised SAP/QAPP before implementation in field.</u>

3.0 BACKGROUND FOR IMPLEMENTATION

It is expected that the monitoring well screen has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, and operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake. For new wells, or for wells without pump intake depth information, the site’s SAP/QAPP must provide clear reasons and instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected. If the depths to top and bottom of the well screen are not known, the SAP/QAPP will need to describe how the sampling depth will be determined and how the data can be used.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU, and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the indicator field parameter criteria in this procedure are met. If after 2 hours of purging indicator field parameters have not stabilized, one of three optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization), c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may reflect a sampling bias and therefore, the data may not meet the data quality objectives of the sampling event).

It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell needs to be used to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

4.0 HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

5.0 CAUTIONS

The following cautions need to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture along the sampling tubing, and squeezing/pinching the pump's tubing which results in a pressure change.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem when using a centrifugal pump or peristaltic pump.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, the sampler will need to shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., dissolved oxygen meter, etc.) can result in faulty data being collected.

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby).

Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely checked to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exist) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be needed.

6.0 PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. OSHA regulations may require the sampler to take the 40 hour OSHA health and safety training course and a refresher course prior to engaging in any field activities, depending upon the site and field conditions.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with, the site Health and Safety Plan, all relevant SOPs, and SAP/QAPP (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

7.0 EQUIPMENT AND SUPPLIES

A. Informational materials for sampling event

A copy of the current Health and Safety Plan, SAP/QAPP, monitoring well construction data, location map(s), field data from last sampling event, manuals for sampling, and the monitoring instruments' operation, maintenance, and calibration manuals should be brought to the site.

B. Well keys.

C. Extraction device

Adjustable rate, submersible pumps (e.g., centrifugal, bladder, etc.) which are constructed of stainless steel or polytetrafluoroethylene (PTFE, i.e. Teflon®) are preferred. PTFE, however, should not be used when sampling for per- and polyfluoroalkyl substances (PFAS) as it is likely to contain these substances.

Note: If extraction devices constructed of other materials are to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

If bladder pumps are selected for the collection of VOCs and dissolved gases, the pump setting should be set so that one pulse will deliver a water volume that is sufficient to fill a 40 mL VOC vial. This is not mandatory, but is considered a “best practice”. For the proper operation, the bladder pump will need a minimum amount of water above the pump; consult the manufacturer for the recommended submergence. The pump’s recommended submergence value should be determined during the planning stage, since it may influence well construction and placement of dedicated pumps where water-level fluctuations are significant.

Adjustable rate, peristaltic pumps (suction) are to be used with caution when collecting samples for VOCs and dissolved gases (e.g., methane, carbon dioxide, etc.) analyses. Additional information on the use of peristaltic pumps can be found in Appendix A. If peristaltic pumps are used, the inside diameter of the rotor head tubing needs to match the inside diameter of the tubing installed in the monitoring well.

Inertial pumping devices (motor driven or manual) are not recommended. These devices frequently cause greater disturbance during purging and sampling, and are less easily controlled than submersible pumps (potentially increasing turbidity and sampling variability, etc.). This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

D. Tubing

PTFE (Teflon®) or PTFE-lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. As discussed in the previous section, PTFE tubing should not be used when sampling for PFAS. In this case, a suitable alternative such as high-density polyethylene tubing should be used.

PVC, polypropylene or polyethylene tubing may be used when collecting samples for metal and other inorganics analyses.

Note: If tubing constructed of other materials is to be used, adequate information must be provided to show that the substituted materials do not leach contaminants nor cause interferences to the analytical procedures to be used. Acceptance of these materials must be obtained before the sampling event.

The use of 1/4 inch or 3/8 inch (inside diameter) tubing is recommended. This will help ensure that the tubing remains liquid filled when operating at very low pumping rates when using centrifugal and peristaltic pumps.

Silastic tubing should be used for the section around the rotor head of a peristaltic pump. It should be less than a foot in length. The inside diameter of the tubing used at the pump rotor head must be the same as the inside diameter of tubing placed in the well. A tubing connector is used to connect the pump rotor head tubing to the well tubing. Alternatively, the two pieces of tubing can be connected to each other by placing the one end of the tubing inside the end of the other tubing. The tubing must not be reused.

E. The water level measuring device

Electronic ”tape”, pressure transducer, water level sounder/level indicator, etc. should be capable of measuring to 0.01 foot accuracy. Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level “tape” at the start and end of each sampling event.

F. Flow measurement supplies

Graduated cylinder (size according to flow rate) and stopwatch usually will suffice.

Large graduated bucket used to record total water purged from the well.

G. Interface probe

To be used to check on the presence of free phase liquids (LNAPL, or DNAPL) before purging begins (as needed).

H. Power source (generator, nitrogen tank, battery, etc.)

When a gasoline generator is used, locate it downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate samples.

I. Indicator field parameter monitoring instruments

Use of a multi-parameter instrument capable of measuring pH, oxidation/reduction potential (ORP), dissolved oxygen (DO), specific conductance, temperature, and coupled with a flow-through-cell is required when measuring all indicator field parameters, except turbidity. Turbidity is collected using a separate instrument. Record equipment/instrument identification (manufacturer, and model number).

Transparent, small volume flow-through-cells (e.g., 250 mLs or less) are preferred. This allows observation of air bubbles and sediment buildup in the cell, which can interfere with the operation of the monitoring instrument probes, to be easily detected. A small volume cell facilitates rapid turnover of water in the cell between measurements of the indicator field parameters.

It is recommended to use a flow-through-cell and monitoring probes from the same manufacturer and model to avoid incompatibility between the probes and flow-through-cell.

Turbidity samples are collected before the flow-through-cell. A “T” connector coupled with a valve is connected between the pump’s tubing and flow-through-cell. When a turbidity measurement is required, the valve is opened to allow the groundwater to flow into a container. The valve is closed and the container sample is then placed in the turbidimeter.

Standards are necessary to perform field calibration of instruments. A minimum of two standards are needed to bracket the instrument measurement range for all parameters except ORP which use a Zobell solution as a standard. For dissolved oxygen, a wet sponge used for the 100% saturation and a zero dissolved oxygen solution are used for the calibration.

Barometer (used in the calibration of the Dissolved Oxygen probe) and the conversion formula to convert the barometric pressure into the units of measure used by the Dissolved Oxygen meter are needed.

J. Decontamination supplies

Includes (for example) non-phosphate detergent, distilled/deionized water, isopropyl alcohol, etc.

K. Record keeping supplies

Logbook(s), well purging forms, chain-of-custody forms, field instrument calibration forms, etc.

L. Sample bottles

M. Sample preservation supplies (as required by the analytical methods)

N. Sample tags or labels

O. PID or FID instrument

If appropriate, to detect VOCs for health and safety purposes, and provide qualitative field evaluations.

P. Miscellaneous Equipment

Equipment to keep the sampling apparatus shaded in the summer (e.g., umbrella) and from freezing in the winter. If the pump's tubing is allowed to heat up in the warm weather, the cold groundwater may degas as it is warmed in the tubing.

8.0 EQUIPMENT/INSTRUMENT CALIBRATION

Prior to the sampling event, perform maintenance checks on the equipment and instruments according to the manufacturer's manual and/or applicable SOP. This will ensure that the equipment/instruments are working properly before they are used in the field.

Prior to sampling, the monitoring instruments must be calibrated and the calibration documented. The instruments are calibrated using U.S Environmental Protection Agency Region 1 *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017, or latest version or from one of the methods listed in 40CFR136, 40CFR141 and SW-846.

The instruments shall be calibrated at the beginning of each day. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range. At the end of each day, a calibration check is performed to verify that instruments remained in calibration throughout the day. This check is performed while the instrument is in measurement mode, not calibration mode. If the field instruments are being used to monitor the natural attenuation parameters, then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration. Note: during the day if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only), this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation occurs the data from this instrument will need to be qualified or rejected.

9.0 PRELIMINARY SITE ACTIVITIES (as applicable)

Check the well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted).

If needed, lay out a sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, etc.).

Remove well cap and if appropriate measure VOCs at the rim of the well with a PID or FID instrument and record reading in field logbook or on the well purge form.

If the well casing does not have an established reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook (consider a photographic record as well). All water level measurements must be recorded relative to this reference point (and the altitude of this point should be determined using techniques that are appropriate to site's DQOs.

If water-table or potentiometric surface map(s) are to be constructed for the sampling event, perform synoptic water level measurement round (in the shortest possible time) before any purging and sampling activities begin. If possible, measure water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) the day before sampling begins, in order to allow for re-settlement of any particulates in the water column. This is especially important for those wells that have not been recently sampled because sediment buildup in the well may require the well to be redeveloped. If measurement of total well depth is not made the day before, it should be measured after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe may not be necessary unless analytical data or field analysis signal a worsening situation. This SOP cannot be used in the presence of LNAPLs or DNAPLs. If NAPLs are present, the project team must decide upon an alternate sampling method. All project modifications must be approved and documented prior to implementation.

If available check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s). If changes are made in the intake depth or extraction rate(s) used during previous sampling event(s), for either portable or dedicated extraction devices, record new values, and explain reasons for the changes in the field logbook.

10.0 PURGING AND SAMPLING PROCEDURE

Purging and sampling wells in order of increasing chemical concentrations (known or anticipated) are preferred.

The use of dedicated pumps is recommended to minimize artificial mobilization and entrainment of particulates each time the well is sampled. Note that the use of dedicated sampling equipment can also significantly reduce the time needed to complete each sampling event, will promote consistency in the sampling, and may reduce sampling bias by having the pump's intake at a constant depth.

A. Initial Water Level

Measure the water level in the well before installing the pump if a non-dedicated pump is being used. The initial water level is recorded on the purge form or in the field logbook.

B. Install Pump

Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the appropriate depth (may not be the mid-point of the screen/open interval). The Sampling and Analysis Plan/Quality Assurance Project Plan should specify the sampling depth (used previously), or provide criteria for selection of intake depth for each new well. If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well.

Pump tubing lengths, above the top of well casing should be kept as short as possible to minimize heating the groundwater in the tubing by exposure to sun light and ambient air temperatures. Heating may cause the groundwater to degas, which is unacceptable for the collection of samples for VOC and dissolved gases analyses.

C. Measure Water Level

Before starting pump, measure water level. Install recording pressure transducer, if used to track drawdowns, to initialize starting condition.

D. Purge Well

From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. This information is recorded on the purge form or in the field logbook.

Start the pump at low speed and slowly increase the speed until discharge occurs. Check water level. Check equipment for water leaks and if present fix or replace the affected equipment. Try to match pumping rate used during previous sampling event(s). Otherwise, adjust pump speed until there is little or no water level drawdown. If the minimal drawdown that can be achieved exceeds 0.3 feet, but remains stable, continue purging.

Monitor and record the water level and pumping rate every five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump to ensure stabilization of the water level. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. If the initial water level is above the top of the screen do not allow the water level to fall into the well screen. The final purge volume must be greater than the stabilized drawdown volume plus the pump’s tubing volume. If the drawdown has exceeded 0.3 feet and stabilizes, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump’s tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are collected.

Avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples.

Note: the flow rate used to achieve a stable pumping level should remain constant while monitoring the indicator parameters for stabilization and while collecting the samples.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (e.g., bladder, peristaltic), and/or the use of dedicated equipment. For new monitoring wells, or wells where the following situation has not occurred before, if the recovery rate to the well is less than 50 mL/min., or the well is being essentially dewatered during purging, the well should be sampled as soon as the water level has recovered sufficiently to collect the volume needed for all anticipated samples. The project manager or field team leader will need to make the decision when samples should be collected, how the sample is to be collected, and the reasons recorded on the purge form or in the field logbook. A water level measurement needs to be performed and recorded before samples are collected. If the project manager decides to collect the samples using the pump, it is best during this recovery period that the pump intake tubing not be removed, since this will aggravate any turbidity problems. Samples in this specific situation may be collected without stabilization of indicator field parameters. Note that field conditions and efforts to overcome problematic situations must be recorded in order to support field decisions to deviate from normal procedures described in this SOP. If this type of problematic situation persists in a well, then water sample collection should be changed to a passive or no-purge method, if consistent with the site's DQOs, or have a new well installed.

E. Monitor Indicator Field Parameters

After the water level has stabilized, connect the "T" connector with a valve and the flow-through-cell to monitor the indicator field parameters. If excessive turbidity is anticipated or encountered with the pump startup, the well may be purged for a while without connecting up the flow-through-cell, in order to minimize particulate buildup in the cell (This is a judgment call made by the sampler). Water level drawdown measurements should be made as usual. If possible, the pump may be installed the day before purging to allow particulates that were disturbed during pump insertion to settle.

During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, ORP, DO) at a frequency of five minute intervals or greater. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 mLs/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell it would be every ten minutes). If the cell volume cannot be replaced in the five minute interval, then the time between measurements must be increased accordingly. Note: during the early phase of purging, emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments followed by stabilization of indicator parameters. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings are within the following limits:

Turbidity (10% for values greater than 5 NTU; if three Turbidity values are less than 5 NTU, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

All measurements, except turbidity, must be obtained using a flow-through-cell. Samples for turbidity measurements are obtained before water enters the flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities. Record start and stop times and give a brief description of cleaning activities.

The flow-through-cell must be designed in a way that prevents gas bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see Appendix B Low-Flow Setup Diagram). Throughout the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must remain submerged in water at all times.

F. Collect Water Samples

When samples are collected for laboratory analyses, the pump's tubing is disconnected from the "T" connector with a valve and the flow-through-cell. The samples are collected directly from the pump's tubing. Samples must not be collected from the flow-through-cell or from the "T" connector with a valve.

VOC samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

If the pump's flow rate is too high to collect the VOC/dissolved gases samples, collect the other samples first. Lower the pump's flow rate to a reasonable rate and collect the VOC/dissolved gases samples and record the new flow rate.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help ensure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use the following procedure to collect samples: collect non-VOC/dissolved gases samples first, then increase flow rate slightly until the water completely fills the tubing, collect the VOC/dissolved gases samples, and record new drawdown depth and flow rate.

For bladder pumps that will be used to collect VOC or dissolved gas samples, it is recommended that the pump be set to deliver long pulses of water so that one pulse will fill a 40 mL VOC vial.

Use pre-preserved sample containers or add preservative, as required by analytical methods, to the samples immediately after they are collected. Check the analytical methods (e.g. EPA SW-846, 40 CFR 136, water supply, etc.) for additional information on preservation.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter (transparent housing preferred) is required, and the filter size (0.45 µm is commonly used) should be based on the sampling objective. Pre-rinse the filter with groundwater prior to sample collection. Make sure the filter is free of air bubbles before samples are collected. Preserve the filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in groundwater for human health or ecological risk calculations.

Label each sample as collected. Samples requiring cooling will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

G. Post Sampling Activities

If a recording pressure transducer is used to track drawdown, re-measure water level with tape.

After collection of samples, the pump tubing may be dedicated to the well for re-sampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth annually is usually sufficient after the initial low stress sampling event. However, a greater frequency may be needed if the well has a “silting” problem or if confirmation of well identity is needed.

Secure the well.

11.0 DECONTAMINATION

Decontaminate sampling equipment prior to use in the first well, and then following sampling of each subsequent well. Pumps should not be removed between purging and sampling operations. The pump, tubing, support cable and electrical wires which were in contact with the well should be decontaminated by one of the procedures listed below.

The use of dedicated pumps and tubing will reduce the amount of time spent on decontamination of the equipment. If dedicated pumps and tubing are used, only the initial sampling event will require decontamination of the pump and tubing.

Note if the previous equipment blank data showed that contaminant(s) were present after using the below procedure or the one described in the SAP/QAPP, a more vigorous procedure may be needed.

Procedure 1

Decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump and tubing. The pump may be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

Flush the equipment/pump with potable water.

Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.

Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.

Optional - flush with isopropyl alcohol (pesticide grade; must be free of ketones {e.g., acetone}) or with methanol. This step may be required if the well is highly contaminated or if the equipment blank data from the previous sampling event show that the level of contaminants is significant.

Flush with distilled/deionized water. This step must remove all traces of alcohol (if used) from the equipment. The final water rinse must not be recycled.

Procedure 2

Steam clean the outside of the submersible pump.

Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

12.0 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the groundwater samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. Quality control samples include field duplicates, equipment blanks, matrix spike/matrix spike duplicates, trip blanks (VOCs), and temperature blanks.

13.0 FIELD LOGBOOK

A field log shall be kept to document all groundwater field monitoring activities (see Appendix C, example table), and record the following for each well:

Site name, municipality, state.

Well identifier, latitude-longitude or state grid coordinates.

Measuring point description (e.g., north side of PVC pipe).

Well depth, and measurement technique.

Well screen length.

Pump depth.

Static water level depth, date, time and measurement technique.

Presence and thickness of immiscible liquid (NAPL) layers and detection method.

Pumping rate, drawdown, indicator parameters values, calculated or measured total volume pumped, and clock time of each set of measurements.

Type of tubing used and its length.

Type of pump used.

Clock time of start and end of purging and sampling activity.

Types of sample bottles used and sample identification numbers.

Preservatives used.

Parameters requested for analyses.

Field observations during sampling event.

Name of sample collector(s).

Weather conditions, including approximate ambient air temperature.

QA/QC data for field instruments.

Any problems encountered should be highlighted.

Description of all sampling/monitoring equipment used, including trade names, model number, instrument identification number, diameters, material composition, etc.

14.0 DATA REPORT

Data reports are to include laboratory analytical results, QA/QC information, field indicator parameters measured during purging, field instrument calibration information, and whatever other field logbook information is needed to allow for a full evaluation of data usability.

Note: the use of trade, product, or firm names in this sampling procedure is for descriptive purposes only and does not constitute endorsement by the U.S. EPA.

15.0 REFERENCES

Cohen, R.M. and J.W. Mercer, 1993, *DNAPL Site Evaluation*; C.K. Smoley (CRC Press), Boca Raton, Florida.

Robert W. Puls and Michael J. Barcelona, *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*, April 1996 (EPA/540/S-95/504).

U.S. Environmental Protection Agency, 1992, *RCRA Ground-Water Monitoring: Draft Technical Guidance*; Washington, DC (EPA/530-R-93-001).

U.S. Environmental Protection Agency, 1987, *A Compendium of Superfund Field Operations Methods*; Washington, DC (EPA/540/P-87/001).

U.S Environmental Protection Agency, Region 1, *Calibration of Field Instruments (temperature, pH, dissolved oxygen, conductivity/specific conductance, oxidation/reduction [ORP], and turbidity),* March 23, 2017 or latest version.

U.S Environmental Protection Agency, EPA SW-846.

U.S Environmental Protection Agency, 40 CFR 136.

U.S Environmental Protection Agency, 40 CFR 141.

Vroblesky, Don A., Clifton C. Casey, and Mark A. Lowery, Summer 2007, Influence of Dissolved Oxygen Convection on Well Sampling, *Ground Water Monitoring & Remediation* 27, no. 3: 49-58.

APPENDIX A

PERISTALTIC PUMPS

Before selecting a peristaltic pump to collect groundwater samples for VOCs and/or dissolved gases, (e.g., methane, carbon dioxide, etc.) consideration should be given to the following:

- The decision of whether or not to use a peristaltic pump is dependent on the intended use of the data.
- If the additional sampling error that may be introduced by this device is NOT of concern for the VOC/dissolved gases data's intended use, then this device may be acceptable.
- If minor differences in the groundwater concentrations could affect the decision, such as to continue or terminate groundwater cleanup or whether the cleanup goals have been reached, then this device should NOT be used for VOC/dissolved gases sampling. In these cases, centrifugal or bladder pumps are a better choice for more accurate results.

EPA and USGS have documented their concerns with the use of the peristaltic pumps to collect water sample in the below documents.

- "Suction Pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" *A Compendium of Superfund Field Operations Methods*, EPA/540/P-87/001, December 1987.
- "The agency does not recommend the use of peristaltic pumps to sample ground water particularly for volatile organic analytes" *RCRA Ground-Water Monitoring Draft Technical Guidance*, EPA Office of Solid Waste, November 1992.
- "The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and volatiles loss", *Low-flow (Minimal drawdown) Ground-Water Sampling Procedures*, by Robert Puls & Michael Barcelona, April 1996, EPA/540/S-95/504.
- "Suction-lift pumps, such as peristaltic pumps, can operate at a very low pumping rate; however, using negative pressure to lift the sample can result in the loss of volatile analytes", USGS Book 9 Techniques of Water-Resources Investigation, Chapter A4. (Version 2.0, 9/2006).

APPENDIX B

SUMMARY OF SAMPLING INSTRUCTIONS

These instructions are for using an adjustable rate, submersible pump or a peristaltic pump with the pump's intake placed at the midpoint of a 10 foot or less well screen or an open interval. The water level in the monitoring well is above the top of the well screen or open interval, the ambient temperature is above 32°F, and the equipment is not dedicated. Field instruments are already calibrated. The equipment is setup according to the diagram at the end of these instructions.

1. Review well installation information. Record well depth, length of screen or open interval, and depth to top of the well screen. Determine the pump's intake depth (e.g., mid-point of screen/open interval).

2. On the day of sampling, check security of the well casing, perform any safety checks needed for the site, lay out a sheet of polyethylene around the well (if necessary), and setup the equipment. If necessary a canopy or an equivalent item can be setup to shade the pump's tubing and flow-through-cell from the sun light to prevent the sun light from heating the groundwater.

3. Check well casing for a reference mark. If missing, make a reference mark. Measure the water level (initial) to 0.01 ft. and record this information.

4. Install the pump's intake to the appropriate depth (e.g., midpoint) of the well screen or open interval. Do not turn-on the pump at this time.

5. Measure water level and record this information.

6. Turn-on the pump and discharge the groundwater into a graduated waste bucket. Slowly increase the flow rate until the water level starts to drop. Reduce the flow rate slightly so the water level stabilizes. Record the pump's settings. Calculate the flow rate using a graduated container and a stop watch. Record the flow rate. Do not let the water level drop below the top of the well screen.

If the groundwater is highly turbid or discolored, continue to discharge the water into the bucket until the water clears (visual observation); this usually takes a few minutes. The turbid or discolored water is usually from the well-being disturbed during the pump installation. If the water does not clear, then you need to make a choice whether to continue purging the well (hoping that it will clear after a reasonable time) or continue to the next step. Note, it is sometimes helpful to install the pump the day before the sampling event so that the disturbed materials in the well can settle out.

If the water level drops to the top of the well screen during the purging of the well, stop purging the well, and do the following:

> Wait for the well to recharge to a sufficient volume so samples can be collected. This may take a while (pump may be removed from well, if turbidity is not a problem). The project manager will need to make the decision when samples should be collected and the reasons recorded in the site's log book. A water level measurement needs to be performed and recorded before samples are collected. When samples are being collected, the water level must not drop below the top of the screen or open interval. Collect the samples from the pump's tubing. Always collect the VOCs and dissolved gases samples first. Normally, the samples requiring a small volume are collected before the large volume samples are collected just in case there is not sufficient water in the well to fill all the sample containers. All samples must be collected, preserved, and stored according to the analytical method. Remove the pump from the well and decontaminate the sampling equipment.

If the water level has dropped 0.3 feet or less from the initial water level (water level measure before the pump was installed); proceed to Step 7. If the water level has dropped more than 0.3 feet, calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well after the water level has stabilized before samples are be collected.

7. Attach the pump's tubing to the "T" connector with a valve (or a three-way stop cock). The pump's tubing from the well casing to the "T" connector must be as short as possible to prevent the groundwater in the tubing from heating up from the sun light or from the ambient air. Attach a short piece of tubing to the other end of the end of the "T" connector to serve as a sampling port for the turbidity samples. Attach the remaining end of the "T" connector to a short piece of tubing and connect the tubing to the flow-through-cell bottom port. To the top port, attach a small piece of tubing to direct the water into a calibrated waste bucket. Fill the cell with the groundwater and remove all gas bubbles from the cell. Position the flow-through-cell in such a way that if gas bubbles enter the cell they can easily exit the cell. If the ports are on the same side of the cell and the cell is cylindrical shape, the cell can be placed at a 45-degree angle with the ports facing upwards; this position should keep any gas bubbles entering the cell away from the monitoring probes and allow the gas bubbles to exit the cell easily (see Low-Flow Setup Diagram). Note:

make sure there are no gas bubbles caught in the probes' protective guard; you may need to shake the cell to remove these bubbles.

8. Turn-on the monitoring probes and turbidity meter.

9. Record the temperature, pH, dissolved oxygen, specific conductance, and oxidation/reduction potential measurements. Open the valve on the "T" connector to collect a sample for the turbidity measurement, close the valve, do the measurement, and record this measurement. Calculate the pump's flow rate from the water exiting the flow-through-cell using a graduated container and a stop watch, and record the measurement. Measure and record the water level. Check flow-through-cell for gas bubbles and sediment; if present, remove them.

10. Repeat Step 9 every 5 minutes or as appropriate until monitoring parameters stabilized. Note: at least one flow-through-cell volume must be exchanged between readings. If not, the time interval between readings will need to be increased. Stabilization is achieved when three consecutive measurements are within the following limits:

Turbidity (10% for values greater than 5 NTUs; if three Turbidity values are less than 5 NTUs, consider the values as stabilized),
Dissolved Oxygen (10% for values greater than 0.5 mg/L, if three Dissolved Oxygen values are less than 0.5 mg/L, consider the values as stabilized),
Specific Conductance (3%),
Temperature (3%),
pH (± 0.1 unit),
Oxidation/Reduction Potential (±10 millivolts).

If these stabilization requirements do not stabilize in a reasonable time, the probes may have been coated from the materials in the groundwater, from a buildup of sediment in the flow-through-cell, or a gas bubble is lodged in the probe. The cell and the probes will need to be cleaned. Turn-off the probes (not the pump), disconnect the cell from the "T" connector and continue to purge the well. Disassemble the cell, remove the sediment, and clean the probes according to the manufacturer's instructions. Reassemble the cell and connect the cell to the "T" connector. Remove all gas bubbles from the cell, turn-on the probes, and continue the measurements. Record the time the cell was cleaned.

11. When it is time to collect the groundwater samples, turn-off the monitoring probes, and disconnect the pump's tubing from the "T" connector. If you are using a centrifugal or peristaltic pump check the pump's tubing to determine if the tubing is completely filled with water (no air space).

All samples must be collected and preserved according to the analytical method. VOCs and dissolved gases samples are normally collected first and directly into pre-preserved sample containers. However, this may not be the case for all sampling locations; the SAP/QAPP should list the order in which the samples are to be collected based on the project's objective(s). Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

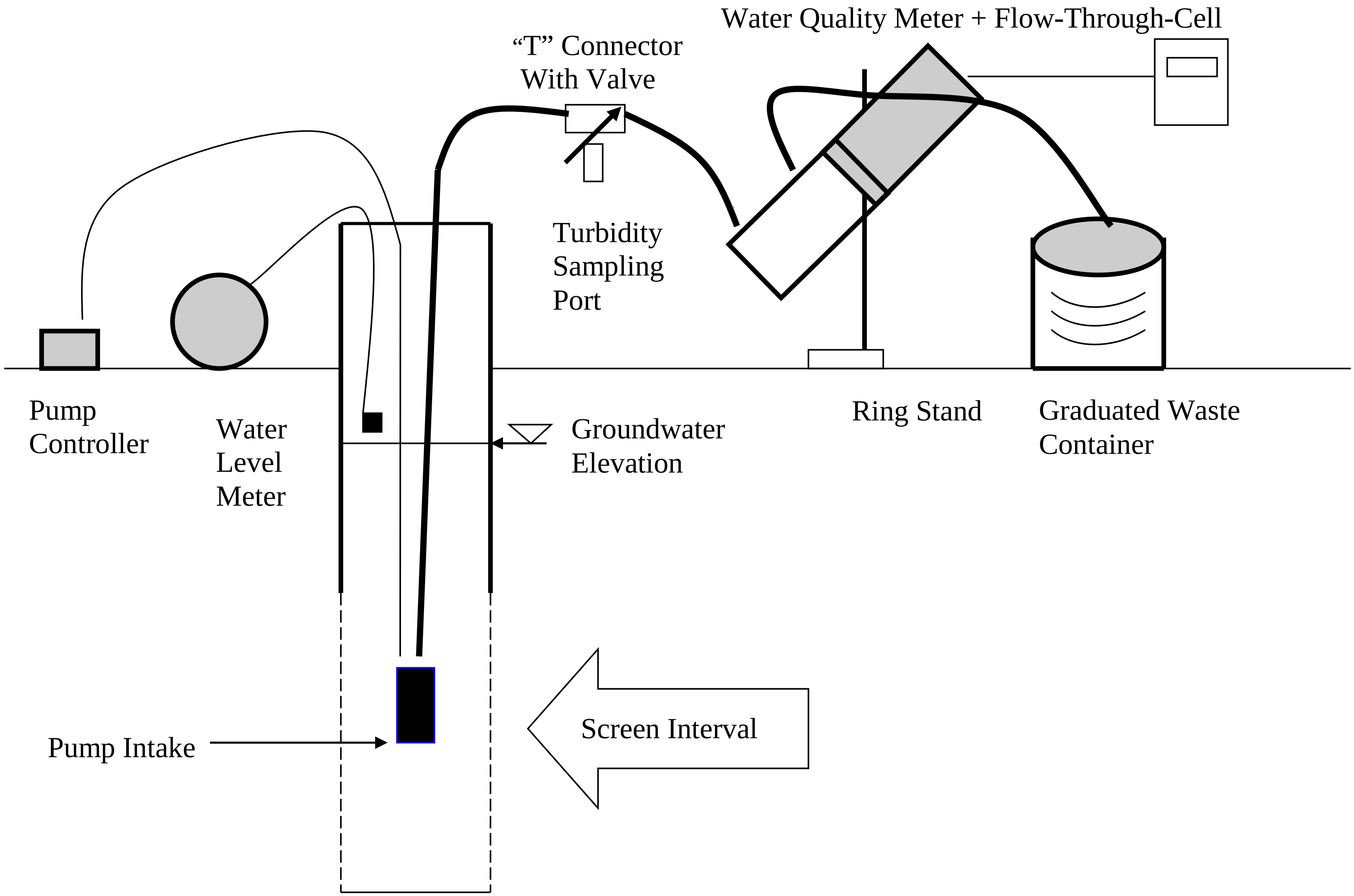
If the pump's tubing is not completely filled with water and the samples are being collected for VOCs and/or dissolved gases analyses using a centrifugal or peristaltic pump, do the following:

> All samples must be collected and preserved according to the analytical method. The VOCs and the dissolved gases (e.g., methane, ethane, ethene, and carbon dioxide) samples are collected last. When it becomes time to collect these samples increase the pump's flow rate until the tubing is completely filled. Collect the samples and record the new flow rate.

12. Store the samples according to the analytical method.

13. Record the total purged volume (graduated waste bucket). Remove the pump from the well and decontaminate the sampling equipment.

Low-Flow Setup Diagram



APPENDIX C

EXAMPLE (Minimum Requirements)

WELL PURGING-FIELD WATER QUALITY MEASUREMENTS FORM

Location (Site/Facility Name)________________________________
Well Number________________ Date________________________
Field Personnel____
Sampling Organization______________________________________
Identify MP____

Depth to _______/________ of screen
(below MP) top bottom
Pump Intake at (ft. below MP)_________
Purging Device; (pump type)__________
Total Volume Purged _______________

Clock Time 24 HR	Water Depth below MP ft	Pump Dial[1]	Purge Rate ml/min	Cum. Volume Purged liters	Temp. "C	Spec. Cond.[2] µS/cm	pH	ORP[3] mv	DO mg/L	Tur-bidity NTU	Comments
Stabilization Criteria					3%	3%	±0.1	±10 mv	10%	10%	

1. Pump dial setting (for example: hertz, cycles/min, etc).
2. µSiemens per cm(same as µmhos/cm)at 25°C.
3. Oxidation reduction potential (ORP)

APPENDIX E
ANNUAL LAND USE CONTROL CHECKLISTS

Table E-1
Checklist for Review of Sudbury Annex (AOC A7) Annual Report

Annual Report Checklist Review	Summary	OK?
Changes to the use of the site?		
Containment System Intact?		
Monitoring System Operational?		
Site Free of Disruptions Deeper than 4 feet?		
Monitoring Wells Intact (vs. Negatively Affected)?		
Water Table Unaffected (vs. Negatively Affected)?		

Table E-2
Checklist for USFWS
Interview

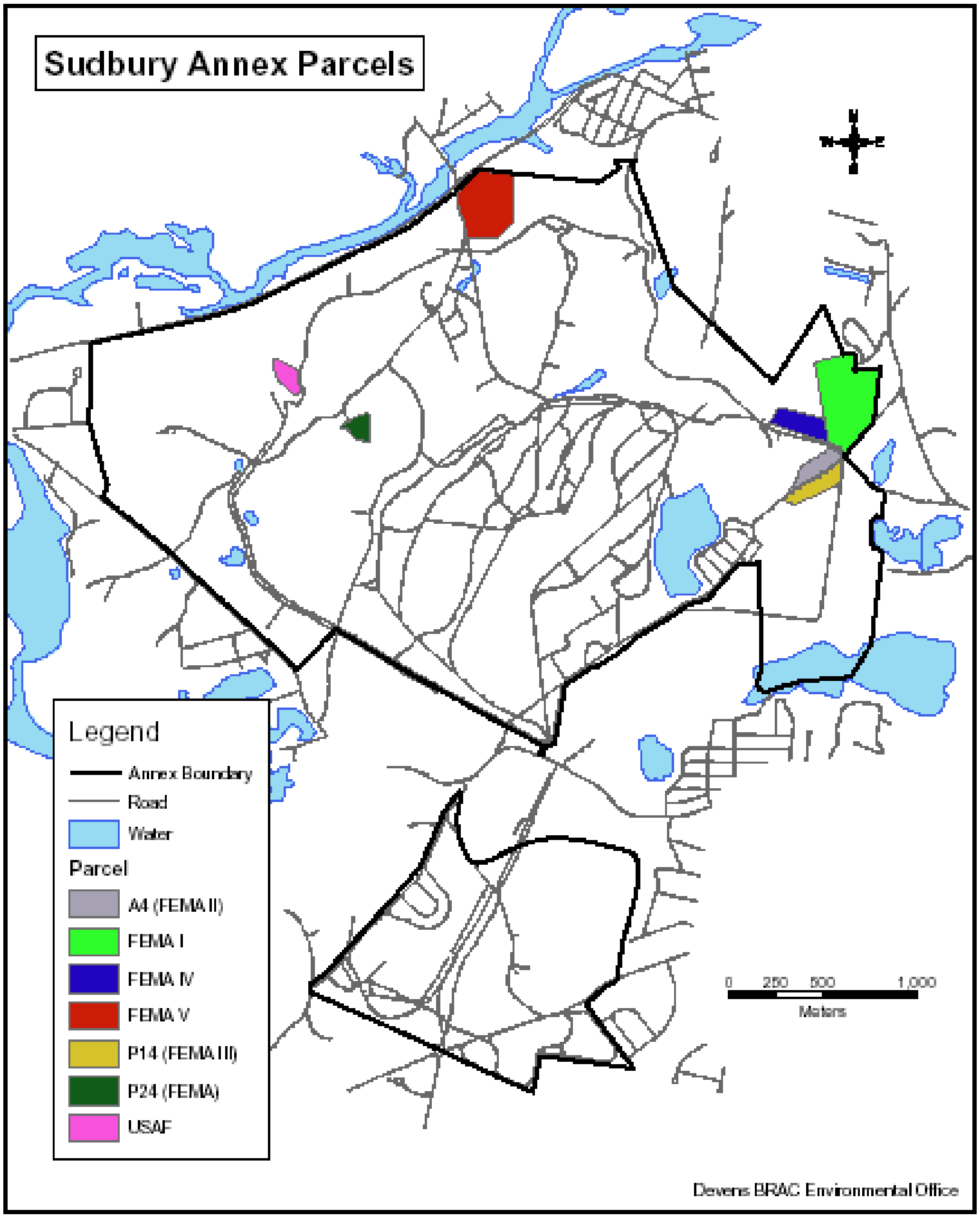
	USFWS Interview Checklists	Summary	OK ?
1	Changes to the use of the site?		
2	Approved conditional exemptions, amendments and/or releases		
3	Unauthorized uses and activities		
4	Review of corrective action to resolve unauthorized uses and activities		
5	Overall effectiveness of the institutional controls		
6	Status of anticipated future redevelopment or other construction or demolition activities		

INSTITUTIONAL CONTROL INTERVIEW QUESTIONS FORMER SUDBURY TRAINING ANNEX (AOC A7) – SUDBURY, MA for United States Fish and Wildlife Service (USFWS)	
Name: **Organization/Title:** **Email:** **Phone:**	
1) Are you aware of any changes to the way the property has been used since January 2020?	
2) Are you aware of any changes to any buildings, boundary walls, or fences since January 2020?	
3) Are you aware of any significant clearing of trees or brush since January ?	
4) The Army has a concern with any construction activities that might disturb or negatively impact the soils, especially below a depth of four feet. Are you aware of any new construction or repairs to existing building since January 2020?	
5) Are you aware of any trespassing that led to any environmental damage since January 2020?	
6) Are you aware of any excavations by either animals or people that might have disturbed or negatively impacted the soils, particularly below a depth of four feet?	
7) Are you aware of any spills or dumping processes that potentially disturbed or negatively impacted the soils since January 2020?	
8) Are there any other circumstances that you are aware of that disturbed the soils, especially below four feet, or otherwise negatively affecting the integrity of the institutional controls (fences, landfill cap)?	

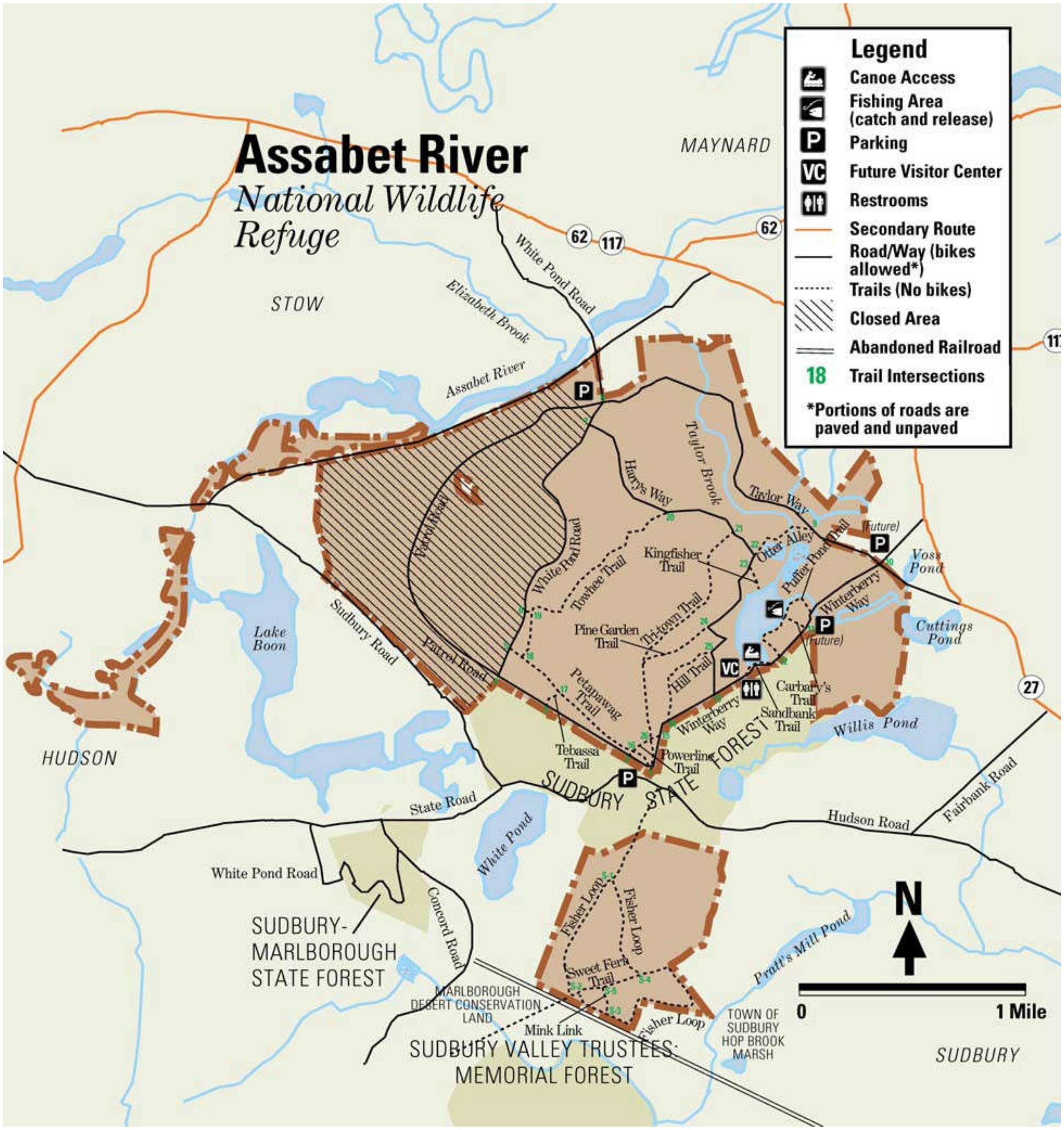
Table E-3
Checklist for FEMA Interview

	FEMA Interview Checklists	Summary	OK ?
1	Changes to the use of the site?		
2	Approved conditional exemptions, amendments and/or releases		
3	Unauthorized uses and activities		
4	Review of corrective action to resolve unauthorized uses and activities		
5	Overall effectiveness of the institutional controls		
6	Status of anticipated future redevelopment or other construction or demolition activities		

INSTITUTIONAL CONTROL INTERVIEW QUESTIONS FORMER SUDBURY TRAINING ANNEX (AOC A7) – SUDBURY, MA for Federal Emergency Management Agency (FEMA)	
Name: **Organization/Title:** **Email:** **Phone:** **Interview date:**	
1) Are you aware of any changes to the way the property has been used since January 2020?	
2) Are you aware of any changes to any buildings, boundary walls, or fences since January 2020?	
3) Are you aware of any significant clearing of trees or brush since January 2020?	
4) The Army has a concern with any construction activities that might disturb or negatively impact the soils, especially below a depth of four feet. Are you aware of any new construction or repairs to existing building since January 2020?	
5) Are you aware of any trespassing that led to any environmental damage since January 2020?	
6) Are you aware of any excavations by either animals or people that might have disturbed or negatively impacted the soils, particularly below a depth of four feet?	
7) Are you aware of any spills or dumping processes that potentially disturbed or negatively impacted the soils since January 2020?	
8) Are there any other circumstances that you are aware of that disturbed the soils, especially below four feet, or otherwise negatively affecting the integrity of the institutional controls (fences, landfill cap)?	



Project: W912WJ-10-D-0003 Revised: 4/06/2015 Figure from M2 and HGL, 2014 Annual Report		**Figure E.1** **Former Sudbury Training Annex Parcel Owners**



Project: W912WJ-10-D-0003
Revised: 04/06/2015
Figure from M2 and HGL, 2014 Annual Report

Figure E.2
Former Sudbury Training Annex: Assabet River NWR Layout

Figure 1-1
Site Location
Former Sudbury Training Annex

Aerial Sources: Esri, DigitalGlobe, GeoEye, i-cubed, USDA FSA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Legend
- Area of Contamination (AOC)
- Area of Contamination Perimeter
- Surface Water Course
- Major Road
- Former Sudbury Training Annex

2019 LongTerm Monitoring and Maintenance Plan
Former Sudbury Training Annex (AOC A7)

Former Fort Devens Army Installation
Sudbury Training Annex, Sudbury, MA

KOMAN Government Solutions, LLC
293 Boston Post Road West, Suite 100, Marlborough, MA 01752

0 1,000 2,000
Feet

Date:
01/24/2019

Figure
1-1

KGS

File: SUD_2018FALL_LTM_F1-1-SiteLocation.mxd

APPENDIX F
RESPONSES TO COMMENTS

U.S. ARMY RESPONSES TO USEPA COMMENTS ON THE DRAFT LONG-TERM MONITORING AND MAINTENANCE PLAN FOR FORMER SUDBURY TRAINING ANNEX, SUDBURY, MA

The following U.S. Army responses pertain to the United States Environmental Protection Agency (USEPA) comments, dated 28 January 2020, on the draft *Long-Term Monitoring and Maintenance Plan (LTMMP) for Former Sudbury Training Annex*, submitted on 12 December 2019.

USEPA GENERAL COMMENT

USEPA Comment 1 – LUC Boundaries: Based on comments and responses related to the PFAS investigation at A9, it was understood that the extent of the LUC boundaries from A7 would be extended to A9. Therefore, this draft plan should include this addition both in the text and figures. Moreover, EPA requests submission of the work plan for additional investigations at A9 and P13 which was promised in an email dated December 12, 2019 from James Ropp to the group.

> ***Army Response:*** *Section 4.1 of the LTMMP has not been revised to indicate that the LUC boundaries will be extended from A7 to A9 for this document. LUC boundaries will be extended from AOC A7 to AOC A9 after further delineation of PFAS under the Site Inspection (SI) program where the Army plans to implement formal LUCs through an Explanation of Significant Differences (ESD) to AOC A9. A revised LTMMP with LUC boundary extensions will be prepared after the ESD.*
>
> *The Army plans to submit a Supplemental SI Work Plan for additional field investigations to delineate the extent of PFAS at AOCs A9 and P11/13 which will also support the delineation of LUCs. The Army plans to implement formal LUCs through an Explanation of Significant Differences (ESD) to the AOC A9 and P11/P13. The LUCs will include restrictions on groundwater extraction, restrictions to control exposures to PFAS-contaminated soil at AOC A9, a legal instrument to impose the controls, annual inspections and reporting, and five-year reviews. The ESDs and LUCs will be prepared after completion of the Supplemental SI sampling and SI Report.*

USEPA SPECIFIC COMMENTS

USEPA Comment 1 – Cover Page, Title – Add “A7 and P31/P58” to title. Pending recognition of general comment #1, add “A9” to the cover page as well.

> ***Army Response:*** *The LTMMP title has been revised to “Long-Term Monitoring and Maintenance Plan for Area of Contamination A7, Former Sudbury Training Annex.” AOCs A9, P31, and P58 are not included as there is no remedial action requiring monitoring or LUCs at those sites. Section 1.1 of the LTMMP has been clarified accordingly. See also the response to Specific Comment #6.*

USEPA Comment 2 – Page 1-3 (should be 1-1), Section 1.1, Para 1, 1st Sentence – Identify the site names to which this document applies.

Army Response: *Section 1.1, Para 1, 2nd Sentence has been revised to read as follows:*

> *"KGS has prepared this Long-Term Monitoring and Maintenance Plan (LTMMP) for A7 to update the current long-term monitoring (LTM) approach for the former Sudbury Training Annex."*

USEPA Comment 3 – Page 1-3 (should be 1-1), Section 1.1, Para 1, 2nd Sentence – Add a reference (or references) to Records of Decision which apply to this plan.

Army Response: *Section 1.1, Para 1, 3rd Sentence has been revised to read as follows:*

> *"Updates to the LTM approach are warranted to account for changes in contaminant distribution and progress towards achieving the goals stated in the Record of Decision (ROD) (OHM, 1995) and the ROD for Management of Migration (ABB, 1997) ."*

USEPA Comment 4 – Page 1-3 (should be 1-1), Section 1.1, Para 2, Last Sentence – Add a reference to the optimization report.

Army Response: *Section 1.1, Para 2, Last Sentence has been revised to read as follow:*

> *"This LTMMP revision includes the optimization recommendations determined during performance of the optimization evaluation (see Appendix A of the 2015 LTMMP, Sovereign, 2015) and does not reproduce the in-depth discussions contained within the optimization report."*

USEPA Comment 5 – Page 1-1 (should be 1-1), Section 1.2 – For consistency, edit "Sudbury Annex" to "Former Sudbury Training Annex" and edit subsequent uses to "the Annex" or an acronym.

Army Response: *The first instance in Section 1.1, and subsequent references to the former Sudbury Training Annex, have been revised accordingly.*

USEPA Comment 6 – Page 1-3 (should be 1-1 to 1-2, Section 1.2 – This section should include a brief summary of the decision documents for P31 and P58.

Army Response: *The following paragraph has been added to Section 1.1:*

> *"AOC A7 is the only AOC at the Annex with an existing Remedial Action including operation and maintenance, institutional controls, and land use restrictions. No monitoring or land use controls were specified for AOC A9 in the RODs. AOC P31 was the subject of a No Further Action decision in April 1999 following conclusion of the Final Supplemental Site Investigation Report (HLA, 1999). Groundwater at AOC P58 was monitored by the Army through May 2001 per a 1999 addendum to*

the existing LTMMP for AOC A7 (USACE, 1998); however, groundwater monitoring at AOC P58 ceased in 2002 and all four monitoring wells were decommissioned and no further action is required."

USEPA Comment 7 – Page 1-3 (should be 1-2 to 1-3), Section 1.3 – This section should include a brief summary of the decision documents for P31 and P58.

Army Response: *See the response to Specific Comments #1 and #6.*

USEPA Comment 8 – Page 1-3 (should be 1-3), Section 1.4 – Please clarify the purpose of this section within the context of this work plan. Section 1.0 and its sections could be organized (and subsections retitled) to focus on the work plan. Section 1.4 may not be relevant at this moment in time and better saved for a future submittal.

Army Response: *The text has been clarified accordingly. The intent of Section 1.4 is to show the timeline of monitoring at the landfill and prepare for upcoming events relating to the landfill 30-year post-closure period.*

USEPA Comment 9 – Page 2-2, Section 2.1 Current Evaluation of LTM Data to COC Trends – This evaluation primarily uses State values, but it should also evaluate data against Federal values as found in EPA's Federal MCLs and the periodically updated Regional Screening Level (RSL) Resident Tap water (Https://semspub.epa.gov/work/HQ/199648.pdf). Specifically, the following should be incorporated into the evaluation and described in the text of this section and added to the Table 3-4.

1,1,2,2-Tetrachloroethane, 7.6-02 ug/L (0.076 ppb) at 1E-06
Tetrachloroethane, 5 ppb
Trichloroethene, 5 ppb, Federal MCL
Gamma-BHC (Lindane), 0.20 ppb, Federal MCL

Army Response: *Section 2.1 has been revised to include an update to the evaluation of COC trends using Federal Drinking Water Standards. The A7 and A9 RODs did not include groundwater RAOs, ARARS, or specific cleanup levels. The first LTMMP (USACE, 1998) used the most stringent MCP GW-1 standards. The 2009 LTMMP (HGL, 2009) optimized the program by applying GW-3 standards since there is no potential source of drinking water and because site groundwater discharges to the Assabet River shortly beyond the site boundary. In addition, the third Five Year Review (USACE, 2011) indicates that the annual monitoring program tracked these contaminants since 1997 and compared these concentrations to the MCP GW-1 standards.*

The previously-approved action levels from the 2015 LTMMP (Sovereign, 2015) are included in Table 3-4 and text. The MCLs have been updated for comparative purposes in the text and Table 3-4 for 1,1,2,2-tetrachloroethane, tetrachloroethane, trichloroethene, and gamma-BHC (Lindane). Table 3-4 has also been revised to note the RSLs for 1,1,2,2,-tetrachloroethane. tetrachloroethene, trichloroethene, and Lindane.

USEPA Comment 10 – Section 3.0 – Detection limits need to be selected to meet the screening values in Section 2.0.

> ***Army Response:*** *Section 3.5 has been revised to indicate that the detection limits for COCs are lower than the action levels. A reference to the QAPP Worksheet #15 (KGS, 2016) has been included.*

USEPA Comment 11 – Table 3-4 – See comment above on Section 2.1. Add Revised Federal column. If necessary, revise "Action Level."

> ***Army Response:*** *Table 3-4 has been revised to include updated Federal MCL column.*

USEPA Comment 12 – Table 4-1 – No information on P31/P58. Provide revised draft table in response to comments.

> ***Army Response:*** *AOCs P31 and P58 have not been added because no further action is required at these sites. See also the responses to Comments #1 and #6.*

U.S. ARMY RESPONSES TO MASSDEP FOLLOW-ON COMMENTS ON THE DRAFT LONG-TERM MONITORING AND MAINTENANCE PLAN FOR FORMER SUDBURY TRAINING ANNEX, SUDBURY, MA

The following U.S. Army responses pertain to the Massachusetts Department of Environmental Protection (MassDEP) follow-on comments, dated 23 April 2020, on the Army's 17 April 2020 response document pertaining to the draft *Long-Term Monitoring and Maintenance Plan (LTMMP) for Former Sudbury Training Annex*, issued on 12 December 2019. The original MassDEP comments and Army responses are reprinted here for reference (other comment/responses not shown were accepted by MassDEP and are not repeated here).

MassDEP Comment 2 (1/24/20) – Section 4.0: The plan should be clarified to identify the areas where LUCs monitoring will be conducted under the plan. Section 4.1 suggests the plan only applies to AOCs A7, P31, and P58. Section 4.3 refers to the "AOCs at Sudbury". Table E-3 and Figure E.1 of Appendix E suggest that FEMA will be interviewed to ensure LUCs compliance on parcels other than AOCs A7, P31 and P58. Will LUCs monitoring under the plan be limited to AOCs A7, P31, and P58? Will the FEMA parcels be monitored under the plan? Will base-wide LUCs be monitored under the plan?

> ***Army Response (4/17/20):*** *Section 4.0 has been clarified to indicate that LUC monitoring will be conducted at AOC A7. A proposed LUC extension from A7 to A9 is planned be incorporated based on the upcoming results of the PFAS SI program and Explanation of Significant Differences. Related text, tables, and Appendix E have been updated (see also the response to EPA General Comment 1).*
>
> *In Section 4.3, the text "AOCs at Sudbury" has been replaced with "AOC A7" and the section has been clarified to indicate that FEMA and USFWS will be interviewed for AOC A7. Other FEMA parcels have not been monitored under the previous LTMMP. Section 1.1 has been clarified to indicate that no further action is required for P31/P58 and these sites have been otherwise removed from the LTMMP accordingly.*
>
> **MassDEP Follow-on Comment (4/23/20)** – RTC 2 appears to indicate that a portion of AOC A7 was transferred to FEMA. Is this correct, and if so, will that portion of AOC A7 be identified in the revised LTMMP (figures weren't provided)?
>
>> ***Army Response (6/4/20):*** *A portion of AOC A7 has not been transferred to FEMA. The referenced sentence above ("Other FEMA parcels have not been monitored under the previous LTMMP) is retracted. A Site Location figure has been provided as Figure 1-1.*

MassDEP Comment 4 (1/24/20) – Table 3-1: Please confirm that "Bottom of Well Screen" elevations were converted to NGVD 1988.

> ***Army Response (4/17/20):*** *Table 3-1 footnotes show that the conversion from 1927 NGVD to 1988 NAVD has been applied to the table. All table elevations, including bottom of screen elevations have been converted to 1988 NAVD. Table footnotes were updated to*

include reference to the 2019 location and elevation survey for the replacement well and northern staff gauge.

MassDEP Follow-on Comment (4/23/20) – RTC 4: I'm following-up on this comment to prevent minor errors from propagating into to future annual reports and plans - most of the Bottom-of-Screen elevations listed in Table 3-1 differ from those presented in the recently submitted draft 2019 annual report. Which document has the correct values? Please confirm or correct as appropriate.

Army Response (6/4/20): *The TOC elevations in Table 3-1 are now correct for all wells and include the newly surveyed well SUDA7-19-01 and northern staff gauge. The bottom-of-screen elevations were incorrect in the draft version of Table 3-1 and have been revised to match the USACE database and the 2019 Sudbury Annual Report.*

MassDEP Comment 5 (1/24/20) – Table 3-1 indicates that monitoring surface water levels at the staff gauges is optional. The plan should explain why levels will not be measured during all LTM monitoring events and describe the circumstances that would trigger measurements.

Army Response (4/17/20): *Table 3-1 has been revised to clarify that both staff gauge locations are to be part of the synoptic measurements in the fall. The northern staff gauge was resurveyed in 2019 when replacement well SUD-A7-19-01 was surveyed. The unnamed tributary where the eastern staff gauge is located is often dry and measurements are unreliable at this location; however, water level measurements will be recorded at this location during the annual synoptic event when conditions allow. The two staff gauges were established in 2006 for the purpose of measuring surface water elevations in the Assabet River and to monitor seasonal elevation change of the surface water from the Assabet River dams. AOC A7 staff gauges were installed to indicate the surface water elevations and facilitate evaluation of groundwater/surface water interaction near the AOC A7 landfill.*

MassDEP Follow-on Comment (1/24/20) – RTC 5: The staff gauge TOC Elevations listed in Table 3-1 are reversed from those listed in the draft 2019 annual report. Which document has the correct values? Please confirm or correct as appropriate.

Army Response (6/4/20): *Table 3-1 in the LTMMP document has the correct values for the northern and eastern staff gauge TOC elevations. The draft 2019 Annual Report will be revised accordingly where incorrect TOC elevations were used including text, table(s) and figure(s).*