WORK PLAN AND QUALITY ASSURANCE PROJECT PLAN FOR OCCUPATIONAL EXPOSURE EVALUATION FINAL

GENERAL SERVICES ADMINISTRATION GOODFELLOW FEDERAL COMPLEX ST. LOUIS, MISSOURI

Contract Number GS10F0076K, Order Number GS-06P-10-GX-A-0030/GS-P-06-11-GX-5201

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1.0 INTRODUCTION

1.1 DISTRIBUTION LIST

General Services Administration	Kevin Phillips, Project Manager Ray J. Wessling, Jr., Contract Officer Kevin Santee, Environmental and Building Operations Branch Chief David Hartshorn, Industrial Hygienist
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1.2 PROJECT, TASK ORGANIZATION, AND SCOPE OF WORK

The General Services Administration (GSA) requested that Tetra Tech, Inc., (Tetra Tech) characterize the occupational risks at the Goodfellow Federal Complex (GFC), 4300 Goodfellow Boulevard, St. Louis, Missouri, that may be attributed to on-site legacy contamination associated with former ordnance plant operations. Tetra Tech reviewed 100 environmental reports associated with GFC, and evaluated potential occupational exposures to GSA associates, construction contractors, custodial contractors, operation and maintenance contractors, tenants, and visitors at the GFC. This review/evaluation was based on the nature, magnitude, and extent of contamination historically detected or suspected to be present as a result of historical activities. Tetra Tech identified data gaps, determined whether follow-up investigation had been conducted, and recommended additional investigation where needed.

Based on this Occupational Exposure Characterization Study, Tetra Tech proposed two follow-on projects to address data gaps and associated recommendations. The first project is the Occupational Exposure Evaluation that will be conducted according to this Work Plan and Quality Assurance Project Plan (QAPP). The Occupational Exposure Evaluation is designed to further investigate occupational risks that may be attributed to on-site legacy contamination associated with former ordnance plant operations. This evaluation is designed to fill data gaps and update existing environmental investigation information, focusing primarily on potential contamination within building envelopes and on exterior surfaces. The second project will be a Remedial Investigation. A separate Work Plan and QAPP will be developed for the Remedial Investigation, which will be designed to evaluate cleanup needs attributable to on-site legacy contamination associated with former ordnance plant operations. The primary focus of the Remedial Investigation will be on potential soil and groundwater contamination at the exterior grounds.

Under order number GS-06P-10-GX-A-0030/GS-P-06-11-GX-5201, GSA tasked Tetra Tech to prepare this Work Plan and QAPP for site investigation activities associated with the Occupational Exposure Evaluation at the GFC site in Kansas City, Missouri.

1.3 PROJECT PERSONNEL

Specific responsibilities of the individuals directly involved with the Occupational Exposure Evaluation activities described herein are identified below.

1.3.1 GSA PROJECT MANAGER

The GSA Project Manager establishes the scope of work referenced by Tetra Tech to develop this Work Plan and QAPP (already completed). The GSA Project Manager helps resolve problems and provide details when necessary to help Tetra Tech develop and/or select options for the technical approach and methods to be employed for the investigations and limited removal actions. The GSA Project Manager is responsible for reviewing and approving this Work Plan and QAPP, and all deliverables prepared by Tetra Tech and its subcontractors. The GSA Project Manager is responsible for ensuring that all activities and deliverables are performed in accordance with state and federal regulations. The GSA Project Manager is responsible for transmitting any required deliverables or progress reports to regulatory agencies.

1.3.2 TETRA TECH PROJECT MANAGER

The Tetra Tech Project Manager has responsibility and authority to allocate resources and personnel to accomplish the project tasks documented in this Work Plan and QAPP. The Tetra Tech Project Manager reports directly to the GSA Project Manager. Specific responsibilities of the Tetra Tech Project Manager include:

- Preparing this Work Plan and QAPP, and any necessary Work Plan and QAPP addenda for Occupational Exposure Evaluation activities
- Procuring services from qualified subcontractors to conduct the investigative and analytical activities described herein, and ensuring that the subcontractor Project Managers are qualified and provide adequate staff and equipment support to achieve project requirements
- Arranging site access, and planning and implementing all field activities
- Implementing the requirements of the project Work Plan, QAPP, and Health and Safety Plan (HSP)
- Providing up-to-date schedules of all field activities to the Tetra Tech Project Manager

- Cooperating with any onsite regulatory agency representatives, recording their comments or recommendations, and communicating such correspondence to the GSA Project Manager
- Providing at least weekly updates to the GSA Project Manager during periods of field work
- Preparing required deliverables.

1.3.3 TETRA TECH FIELD TEAM LEADER

The Tetra Tech Project Manager is supported by a field team leader (FTL). The FTL is responsible for directing day-to-day field operations and reporting to the Tetra Tech Project Manager on a daily basis. The FTL monitors field measurement and sampling procedures to verify that requirements of this Work Plan and QAPP are followed. Other specific responsibilities of the FTL include:

- Supervising field staffing and mobilization activities for field work
- Overseeing sample collection and field measurements, and maintaining field logbook(s)
- Ensuring proper chain-of-custody (COC) procedures for sample handling and shipment are followed
- Overseeing activities of all project personnel in the field, including subcontractor field operation personnel
- Providing the Tetra Tech Project Manager with the required planning, cost, and schedule control; records documentation; and data management information related to field activities
- Facilitating the identification and resolution of project-level quality assurance (QA)/quality control (QC) and health and safety problems.

1.3.4 TETRA TECH QUALITY ASSURANCE OFFICER

The Tetra Tech QA Officer is responsible for monitoring the quality of work performed and technical documents generated by Tetra Tech. The Tetra Tech QA Officer works independently of the project team and has authority to initiate a work stoppage to address and resolve quality concerns. Specific Tetra Tech QA Officer responsibilities include the following:

- Reviewing this Work Plan and QAPP, and all Tetra Tech project deliverables
- Working with the Tetra Tech Project Manager to identify QA problems and ensure correct procedures are followed
- Providing corrective action recommendations for all aspects of work that do not meet program standards
- Working with the Tetra Tech Project Manager to implement effective corrective actions

- Managing and overseeing all aspects of laboratory data management and data validation.

1.3.5 TETRA TECH Health AND SAFETY OFFICER

The Tetra Tech Health and Safety Officer is responsible for administration of Tetra Tech's health and safety program. The Tetra Tech Health and Safety Officer works independently of the project team and has authority to initiate a work stoppage because of health and safety concerns. Specific Tetra Tech QA Officer responsibilities include the following:

- Reviewing the project HSP
- Acting in an advisory capacity to the Tetra Tech Project Manager and other Tetra Tech site personnel for project-specific health and safety issues
- Working with the Tetra Tech Project Manager to communicate with officers and representatives of GSA as necessary regarding matters relating to health and safety
- Working with the Tetra Tech Project Manager to identify health and safety problems and ensure correct procedures are followed
- Providing corrective action recommendations for all aspects of work that do not meet program standards
- Working with the Tetra Tech Project Manager to implement effective corrective actions.

1.3.6 DATA USERS

Data users are technical personnel who use the acquired data to fulfill their responsibilities. Data users may include GSA, Tetra Tech and other GSA contractors, the U.S. Environmental Protection Agency (EPA), the Missouri Department of Natural Resources (MDNR), and the Missouri Department of Health and Senior Services.

1.3.7 DECISION MAKERS

Decision makers render decisions based on data acquired during the project. Decision makers include GSA and possibly MDNR.

2.0 SITE DESCRIPTION AND BACKGROUND

This section presents a site description and describes previous assessments of the site.

2.1 SITE DESCRIPTION

The GFC is located at 4300 Goodfellow Boulevard in St. Louis, Missouri (see Appendix A, Figure 1). The GFC is a portion of the former St. Louis Ordnance Plant (SLOP) located near the western boundary of the City of St. Louis, Missouri. The GFC consists of approximately 64 acres, and is bordered on the northwest by Goodfellow Boulevard, on the northeast by SLOP, on the southeast by Industrial Drive, and on the southwest by Edelle Avenue and SLOP (see Appendix A, Figure 2). The GFC is developed with buildings, utility tunnels, and a combined stormwater and sanitary sewer collection system.

Known historical uses of the GFC property include a residence and farmstead (dairy farm) between 1912 and 1925, a community garden between 1936 and 1940, Hickey Park from 1940 to 1941, and Plant 1 of the SLOP from 1941 through the close of World War II. The SLOP reportedly was the largest small-arms ammunition installation in the world, producing small arms ammunition (0.30 and 0.50 caliber) and components for 105 millimeter (mm) artillery shells. In the 1960s and 1970s, the U.S. Department of Defense (DoD) converted Plant 1 to a federal office complex under management of GSA.

Table 1 identifies known historical and current buildings on site, as well as available information regarding construction, use, and renovation of each.

2.2 PREVIOUS ASSESSMENTS

Tetra Tech reviewed approximately 100 documents recording past environmental work at GFC; of these, 86 contained unique information and are summarized in Table 2. Data gaps and outstanding investigation recommendations associated with former ordnance plant operations, identified in that document review, form the basis for conducting the Occupational Exposure Evaluation described in this Work Plan and QAPP. Table 3 summarizes environmental conditions by building, and Tetra Tech's recommendations for addressing issues/risks of occupational exposure.

3.0 SAMPLING DESIGN PLAN AND QUALITY CONTROL

The following sections discuss the approach to additional site investigation in support of the GFC Occupational Exposure Evaluation and QC procedures associated with the sampling. These sections discuss sampling rationale, sample collection and preparation, field measurement procedures, sample custody procedures, and QC samples. Figures identifying planned sampling locations are presented in Appendix A.

3.1 SAMPLING PROCESS DESIGN AND RATIONALE

The proposed sampling scheme for this project is judgmental (based on the best professional judgment of the sampling team), in accordance with the *Guidance for Performing Site Inspections Under CERCLA*, Office of Solid Waste and Emergency Response (OSWER) Directive #9345.1-05, September 1992. The following sections present the sampling process design and rationale for the GFC Occupational Exposure Evaluation.

Based on discussions with GSA, the focus of the GFC Occupational Exposure Evaluation is on contaminants of concern associated with former ordnance plant operations, and not on construction and maintenance materials such as lead-based paint, asbestos-containing building materials (ACBM), polychlorinated biphenyl (PCB)-based caulking, or appropriately applied pesticides and herbicides. Asbestos management plans are in place at occupied buildings where ACBM has been identified.

Buildings 102 and 102D have been mothballed and are no longer maintained or serviced by utilities pending demolition or complete renovation. According to GSA, Building 102D should not be entered without a respirator equipped with proper filtration cartridges or supplied air because of mold issues. GSA has requested no additional investigation at these buildings until their futures are determined.

The following sampling design assumes negotiations for access to all other buildings within the GFC complex; however, GFC tenants might not allow access to their properties. Other GFC tenant restrictions include a prohibition on photography in Building 103 and a prohibition on photography without prior security approval in Building 104.

Sampling locations are shown on Figures 3 through 23 in Appendix A. Tables 4 through 7 in Appendix B present additional details of the sampling design for each building—including sample types, numbers, identifiers, and analyses.

3.1.1 INTERIOR CONCRETE CORE SAMPLING

In buildings where available records are insufficient to verify completion of proper removal and disposal of all PCB-containing equipment, and completion of cleanup where needed, clearance samples will be collected for PCB analysis. Historically, wipe sampling has been conducted for PCB analysis. Although the wipe sampling technique is acceptable for impervious materials, MDNR requires destructive core sampling for concrete and other pervious materials. Tetra Tech will collect destructive core samples for analysis on a mass concentration basis (i.e., mass of analyte per unit mass of sample collected), allowing direct human health risk assessment.

Based on currently available transformer inspection, replacement, and spill cleanup records, concrete core sampling will be conducted in transformer vaults and utility rooms within the following buildings (see Figures in Appendix A and Table 4 in Appendix B):

- 101
- 103 A/B/C
- 103 D
- 103 E
- 103 F (former 112)
- 104 A/B/C/D
- 104 E
- 104 F
- 105 A/B/C/D
- 105 E
- 105 F
- 107
- 108 A
- 108 B
- 110
- 111
- 115
- 122 B
- 141 C
- 208 B

3.1.2 INTERIOR SURFACE DUST SAMPLING

Although wipe samples have been collected from numerous surfaces throughout GFC, many wipe sample results were not directly comparable to Missouri Risk-Based Corrective Action (MRBCA) default target levels (DTL) or EPA regional screening levels (RSL). Therefore, bulk surface dust sampling will occur as necessary to verify wipe sample results, to more directly evaluate risk and mitigation needs, and otherwise to fill data gaps. Surface dust sampling using a micro-vacuum technique allows for collection of a bulk sample that can be analyzed for contaminant concentrations on a mass concentration basis (i.e., mass of metal per unit mass of sample collected), allowing direct human health risk assessment via ingestion, particulate inhalation, and dermal contact pathways. Moreover, the micro-vacuum technique facilitates collection of dust from crevices, irregular surfaces, and hard-to-reach areas that would be difficult to sample otherwise. Because the composition of surface dust on interior building surfaces may be influenced by day-to-day activities such as foot traffic or cleaning, dust samples will be collected from building locations outside primary foot-traffic pathways. If necessary to verify analytical results exceeding risk-based screening levels, indoor surface dust samples will be collected during quarterly sampling events. Targeted contaminants of concern in analyses of bulk surface dust samples will be specified building-by-building, based on former ordnance plant operations within each building.

Historical operations in some buildings may require inclusion of lead or other metals as contaminants of concern.

Based on currently available information, surface dust samples will be collected from the following buildings (see Figures in Appendix A and Table 5 in Appendix B):

- 102 E
- 103 A/B/C
- 103 D
- 103 E
- 103 F (former 112)
- 104 A/B/C/D
- 104 E
- 104 F
- 105 A/B/C/D
- 105 E
- 105 F
- 110
- 115

3.1.3 INTERIOR CRAWLSPACE, TUNNEL, and BASEMENT SURFACE SOIL SAMPLING

In dirt-floor crawlspace, tunnel, and basement areas where no sampling was conducted historically or where past sampling revealed existing contamination, Tetra Tech will collect surface soil samples to support direct assessments of human health risks via ingestion, particulate inhalation, and dermal contact pathways. Targeted contaminants of concern in analyses of surface soil samples will be specified building-by-building, based on former ordnance plant operations within each building. Historical operations in some buildings may require inclusion of lead, other metals, PCBs, semivolatile organic compounds (SVOC), volatile organic compounds (VOC), or total petroleum hydrocarbons (TPH) as contaminants of concern. Although asbestos management plans are in place at occupied buildings where asbestos has been identified, surface soil samples from crawlspace, tunnel, and basement areas also will be tested for asbestos (utility asbestos wrap and waste burial have been found beneath many buildings of this age).

Based on currently available information, surface soil samples will be collected from crawlspaces, tunnels, and basements beneath or leading to the following buildings (see Figures in Appendix A and Table 6 in Appendix B):

- 102 E
- 103 A/B/C
- 103 D
- 103 F (former 112)
- 104 A/B/C/D
- 104 E
- 104 F
- 105 A/B/C/D
- 105 E
- 105F
- 107
- 110
- 115

3.1.4 EXTERIOR SOIL AND GROUNDWATER SAMPLING

At existing building locations where historical building use, tank presence, demolition practices, or analytical data indicate the potential for sufficiently volatile contaminants of concern to volatilize from exterior soil or groundwater to occupied interior spaces, direct-push technology will be used to advance continuous soil cores and collect soil and groundwater samples at exteriors of these buildings. These sample results will be used to conduct vapor intrusion evaluations as described in Section 3.1.5. Exterior soil and groundwater samples also will be collected at former and existing building locations where historical building use, tank presence, demolition practices, or analytical data indicate the potential for direct exposure of construction workers, other workers, or visitors to contaminants of concern in surface soil or (for construction workers only) subsurface soil or groundwater. These sample results will be used to support direct assessments of human health risks via ingestion, particulate inhalation, and dermal contact pathways. Targeted contaminants of concern in analyses of soil and groundwater samples will be specified building-by-building, based on former ordnance plant operations within each building. Sufficiently volatile contaminants of concern may include VOC including 1,4-dioxane, SVOCs, TPHs, PCBs (congener method), pesticides, and herbicides. Other contaminants of concern may include lead and other metals.

Based on currently available information, soil and groundwater samples will be collected within the footprints or around the perimeters of the following buildings to support vapor intrusion evaluation (see Figures in Appendix A and Table 7 in Appendix B):

- 102 F/G/H
- 102 J
- 102 K
- 103 F/G/H
- 104 A/B/C/D
- 104 G/H/J
- 104 K
- 104 L
- 104 M
- 104 N
- 105 M
- 105 N
- 108 A
- 108 B
- 110
- 111
- 115
- 122 B
- 136 A
- 136 B
- 136 E
- 136 F
- 137 A
- 141 C
- 208 B

3.1.5 PHASE II: SUB-SLAB VAPOR SAMPLING

Referencing existing and planned occupational exposure sampling data, Tetra Tech will conduct a tiered vapor intrusion evaluation in accordance with *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (EPA 2002b). If Tier 1 and Tier 2 vapor intrusion evaluations do not lead to a conclusion that no complete vapor intrusion pathway exists, Tetra Tech will conduct a Tier 3 site-specific assessment including (1) survey and removal of all indoor air sources, (2) direct measurement of outdoor (ambient) and indoor air concentrations, (3) direct measurement of foundation air concentrations, and (4) mathematical modeling as appropriate. Targeted contaminants of concern in analyses of sub-slab vapor samples will be specified building-by-building, based on former ordnance plant operations within each building. Sufficiently volatile contaminants of concern may include VOCs (including 1,4-dioxane), SVOCs, TPHs, PCBs (specific congeners), pesticides, and herbicides. Buildings requiring sub-slab vapor sampling will be determined based on results of the first phase of this investigation. If necessary to verify analytical results exceeding risk-based screening levels, sub-slab vapor samples will be collected during additional quarterly sampling events. Tetra Tech will obtain GSA approval of sub-slab vapor sampling locations, analytes, and frequencies prior to proceeding with Phase II.

3.1.6 PHASE II: INDOOR AND AMBIENT AIR SAMPLING

As necessary, based on existing and planned occupational exposure sampling data, Tetra Tech will collect indoor air samples collocated with sub-slab vapor sampling locations to investigate preferential pathways for vapor intrusion, or to confirm potential sources of indoor air contamination. Existing data already indicate need for indoor air sampling for mercury analysis at Buildings 103 F, 104 A/B/C/D, and 105 A/B/C/D. In addition to the indoor air samples, outdoor ambient air samples will be collected to provide information on potential pollutants in outdoor ambient air that may influence indoor air concentrations. Targeted contaminants of concern in analyses of indoor and ambient air samples will be specified building-by-building, based on former ordnance plant operations within each building. Contaminants of concern may include VOCs, SVOCs, TPHs, PCBs (specific congeners), pesticides, herbicides, lead, mercury, or other metals. Buildings requiring indoor and ambient air sampling will be determined based on the results of the first phase of this investigation. If necessary to verify analytical results exceeding risk-based screening levels, additional indoor and ambient air samples will be collected during subsequent quarterly sampling events. Tetra Tech will obtain GSA approval of indoor and ambient air sampling locations, analytes, and frequencies prior to proceeding with indoor and ambient air sampling.

3.2 SCHEDULE

A schedule for completing the work described herein is presented in Table 8 in Appendix B.

3.3 SAMPLING PROCEDURES AND REQUIREMENTS

The following sections describe the sampling procedures, special training requirements, sample handling and custody procedures, equipment decontamination, management of investigation-derived waste (IDW), and documentation of records. Samples will be collected in a manner consistent with the EPA methods and standard operating procedures (SOP). Table 9 in Appendix B summarizes the sampling method requirements.

3.3.1 INTERIOR CONCRETE CORE SAMPLING PROCEDURE

Consistent with MRBCA requirements, Tetra Tech will collect targeted destructive core or equivalent samples of PCB-contaminated concrete, wood, or other pervious materials. Sampling will be consistent with procedures specified in 40 *Code of Federal Regulations* 761.123 and EPA's *Polychlorinated Biphenyl Inspection Manual* (2004).

3.3.2 INTERIOR SURFACE DUST SAMPLING PROCEDURE

At each surface dust sampling location, a bulk dust sample will be collected by micro-vacuum sampling into micro-vac cartridges. Sampling will be consistent with procedures described in ASTM International (ASTM) D7144 *Standard Practice for Collection of Surface Dust by Micro-vacuum Sampling for Subsequent Metals Determination* (2011). The bulk sample will be analyzed to yield a concentration on a mass concentration basis (i.e., mass of metal per unit mass of sampled collected), rather than mass of metal per unit of surface area (this renders unnecessary the difficult measurement of a sampled area with irregular shape). Sampling should occur over an area sufficiently large to obtain at least 1 gram of sample.

3.3.3 INTERIOR SURFACE SOIL SAMPLING PROCEDURE

Surface soil samples will be collected from 0 to 6 inches below ground surface (bgs) using a disposable stainless steel spoon. The soil will be homogenized in a disposable aluminum pie pan, and placed in a laboratory-supplied container.

3.3.4 EXTERIOR SOIL AND GROUNDWATER SAMPLING PROCEDURE

Direct-Push Soil Sampling – Exterior soil samples will be collected using a Geoprobe Macro-Core sampler fitted with disposable polyvinyl chloride (PVC) or acetate liners. Soil samples will be collected in general accordance with EPA Environmental Response Team (ERT) SOP 2012, *Soil Sampling* (EPA 2000b). At each location, a continuous soil core will be collected in 4-foot segments. Each 4-foot core interval will be screened for contamination using a hand-held photoionization detector (PID) and via visual and olfactory detections. At each boring location, one soil sample will be collected from the zone having the highest apparent contamination based on PID readings, odor, or visual staining. In the absence of apparent contamination, the soil sample will be collected from a random interval within the vadose (unsaturated) zone.

Soil to be analyzed for VOCs or TPH gasoline-range organics (GRO) will be sampled using a TerraCore sampling kit (or equivalent kit) (refer to EPA Method 5035, Appendix A, Paragraph A.7.1.1 – *Subsampling of Cohesive Granular but Uncemented Materials Using Devices Designed to Obtain a Sample Appropriate for Analysis* [EPA 1996]). The remaining soil will be removed from the PVC or acetate liner and placed in a disposable aluminum pie pan for homogenization, and then transferred to laboratory-supplied containers. All soil samples will be labeled, recorded on a chain of custody, and stored in coolers maintained at or below 4°C pending submittal to the contracted laboratory.

The following information will be recorded in the field logbook for each probe location:

- Location latitude and longitude (as recorded using a global positioning system [GPS])
- Boring log indicating PID readings
- Sample interval or depth, where appropriate (in feet bgs)
- Physical description of the core sample
- Depth at which the water table is encountered
- Additional observations such as odor, staining, and presence of organic materials.

Direct-Push Groundwater Sampling – Groundwater samples will be collected in general accordance with EPA ERT SOP 2007, *Groundwater Well Sampling* (EPA 1995). Groundwater samples will be collected from temporary monitoring wells created using a Geoprobe Screen Point 15 sampling apparatus with a disposable 4-foot-long PVC screen, or similar type of apparatus. Groundwater samples will be co-located with select soil sample locations. At each location, the screen will be deployed directly below the water table, and a sample will be collected through disposable polyethylene tubing using either a peristaltic pump or a check valve placed at the bottom of the tubing. If sufficient groundwater is available, approximately three tubing volumes of groundwater will be purged prior to sampling.

Groundwater samples will be collected in order of volatilization. Groundwater collected for dissolved metals analysis will be filtered in the field using a Nalgene Filter Unit (or equivalent) with 45-micron filter. Groundwater collected for total metals analysis and all other analyses will be unfiltered. Groundwater samples will be collected in laboratory-supplied containers. All groundwater samples will be labeled, recorded on a chain of custody, and stored in coolers maintained at or below 4°C pending submittal to the contracted laboratory.

The following information will be recorded in the field logbook for each probe location:

- Location latitude and longitude (as recorded using a GPS)
- Screen interval or sample depth (in feet bgs)
- Physical description of the groundwater sample
- Additional observations such as odor or sheen.

3.3.5 SUB-SLAB VAPOR SAMPLING PROCEDURE

Installation of Sub-Slab Sampling Ports – At each sub-slab soil gas sampling location, permanent sampling ports will be installed, as described in general accordance with *Draft SOP for Installation of Sub-Slab Vapor Probes and Sampling Using EPA Method TO-15 to Support Vapor Intrusion Investigations* (EPA 2002a).

Sub-Slab Sampling with Summa Canisters – Prior to collecting samples into Summa canisters, sub-slab vapors will be screened at each sampling port using a RAE Systems ppbRAE, and the results will be documented in field notes. Sub-slab vapor samples collected for VOC analysis will be drawn through the sampling ports and collected into Summa canisters. Disposable 0.25-inch-diameter polyethylene tubing (approximately 3 feet long) will be connected to a Swagelok fitting on the sampling port and to a passive flow regulator attached to an evacuated Summa canister. The flow regulator will be calibrated to enable collection of sub-slab vapors over a continuous 1-hour period. Prior to initiation of sample collection at each sub-slab location, a field test will be conducted to ensure no leaks are present between the sub-slab inlet and the Summa canister. For this test, a portable enclosure will be placed over the sampling probe, sample tubing, and Summa canister, and helium gas will be introduced into the enclosure. An aliquot of soil gas from the sample tubing line will be collected in an attached Tedlar bag (using a sampling pump or vacuum pump), and then vapors in the bag will be screened for helium using a hand-held detector. If no helium above background is detected, it will be assumed that no leaks exist (i.e., no helium has entered the tubing through a poorly sealed probe, vacuum gauge, flow regulator, or tubing connectors), and sampling can proceed. The sampling line will be purged before sample collection begins. Sub-slab vapor sampling using Summa canisters will be conducted in accordance with procedures in the *Draft SOP for Installation of Sub-Slab Vapor Probes and Sampling Using EPA Method TO-15 to Support Vapor Intrusion Investigations* (EPA 2002a).

Sub-Slab Sampling with Low-Volume Mini-PUF Tubes – At select locations, sampling for PCBs will be conducted using low-volume mini-polyurethane foam (mini-PUF) sample tubes. The mini-PUF sampling apparatus will consist of a mini-PUF tube placed in a multi-purpose calibration jar. The inlet of the jar will be connected to the sub-slab probe, and the outlet of the jar will be connected to a low-flow sampling pump. Disposable 0.25-inch-diameter polyethylene tubing will be used to connect the multi-purpose calibration jar to the sub-slab port and sampling pump. The sampling pump will be calibrated to operate at 5 liters per minute. A leak test of each setup will be conducted prior to initiation of sample collection, as previously described for the sub-slab Summa samples. During sample collection, the sampling pumps will be allowed to run for up to 24 hours. Mini-PUF sampling will be conducted in accordance with EPA Method TO-10A, *Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using Low Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detention (GC/MD)* (EPA 1999a).

3.3.6 INDOOR AND AMBIENT AIR SAMPLING PROCEDURE

Prior to indoor air sampling, the area being sampled will be inspected for stored chemicals, fuels, and other products that may contribute VOCs, PCBs, and/or mercury to indoor air (e.g. cleaning supplies, paint, automotive fluids, and solvents). Potential sources will be documented in field notes (e.g. "six 1-gallon containers of latex paint") and photographed. Indoor air sampling will be conducted under conditions representing actual site conditions; therefore, identified containers of chemicals will not be sealed in plastic bags or removed from the area being sampled. Prior to sampling, each indoor and ambient air sampling location will be screened with a RAE Systems ppbRAE, and the results will be documented in field notes. (Note: because sub-slab vapor sampling with mini-PUF tubes may introduce sub-slab vapors into the rooms where sampling is taking place, sub-slab vapor sampling should not be started until indoor air samples have been collected, if both types of sampling are to be conducted during the same sampling event).

Indoor/Ambient Air Sampling with Summa Canisters – For indoor and ambient air sampling locations where sampling for VOCs will be conducted, a Summa canister will be fitted with a passive flow regulator to enable collection of an air sample for a continuous 24-hour period. A GPS device will be used to obtain the latitude and longitude coordinates for each outdoor (ambient) sampling location, and the coordinates will be recorded in a field logbook. Indoor air and ambient air sampling will be conducted in accordance with EPA Method TO-15, *Determination of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography Mass Spectrometry (GC/MS)* (EPA 1999a).

Indoor/Ambient Air Sampling with High-Volume PUF Cartridges – For indoor and ambient air sampling locations where sampling for PCBs will be conducted, a PS-1 sampler fitted with a high-volume PUF cartridge (pre-cleaned by the contracted laboratory) will be used. The PS-1 samplers will be operated for 24 hours at flow rates of approximately 200 to 280 liters per minute. The PS-1 sampling will be conducted in accordance with EPA Method TO-4A, *Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detention (GC/MD)* (EPA 1999a).

Indoor/Ambient Air Sampling with Solid Hopcalite Sorbent Tubes – For indoor and ambient air sampling locations where sampling for mercury will be conducted, a programmable personal sampling pump will be used to pump air through a solid Hopcalite sorbent material contained in a glass tube. Sampling will be consistent with procedures described in EPA ERT SOP # 1827 – *Analysis of Mercury in Air with a Modified NIOSH 6009 Method* (EPA 1999b), modified NIOSH Method 6009 – *Elements by ICP* (NIOSH 2003), and EPA Environmental Response Team (ERT) Standard Operating Procedure #2119 – *Air Sampling for Metals* (EPA 1994). Samples will be collected during a typical workday (a non-holiday weekday). The sampling pumps will be operated at approximately 0.25 to 0.5 liters per minute.

3.3.7 CORRECTIVE ACTION

In general, corrective actions for field sampling and measurement failures will include recalibrating instruments, repairing or replacing malfunctioning measurement instruments or sampling equipment, repeating measurements, or re-collecting samples.

3.3.8 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

All site personnel will be required to have completed a basic 40-hour health and safety (Hazardous Waste Operations and Emergency Response) training course and annual refreshers. Geoprobe sampling will be conducted by an experienced operator under a corporate drilling license with the State of Missouri.

3.3.9 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIME REQUIREMENTS

Sample container, preservation, and holding time requirements are described in Table 10. Tetra Tech will obtain all sample containers from the contracted analytical laboratory and will coordinate with the laboratory to determine required sampling container volume.

3.3.10 SAMPLE HANDLING AND CUSTODY PROCEDURES

The field team will follow appropriate COC procedures for each sample from the time it is collected until shipment to the laboratory. Samples will be retained at all times in the field crew's custody until shipment. The field crew will ship samples to the laboratory at the end of each day or sampling event, as appropriate, to meet the required sample holding times. Sample custody will begin when the samples are placed into a cooler or other appropriate container in the possession of the designated field sample custodian. The sampler will sign and date the COC form, record the time, and confirm that all descriptive information contained on the form is complete. Example COC forms are in Appendix C.

All samples will be packaged and labeled for shipment in compliance with current Department of Transportation regulations. Only metal or plastic ice chests will be used. Ice chests used to ship aqueous samples will be lined with two plastic bags; the plastic bags around the aqueous samples will be sealed by twisting the tops and securely taping the bags closed to prevent leaks. The drain holes inside the chests will be taped shut. Styrofoam, bubble wrap, or other packing materials will be used to absorb shock during shipment. COC records and any other shipping and sample documentation will accompany each shipment. These documents will be enclosed in a waterproof plastic bag and taped to the underside of the cooler lid. A temperature blank will be included in each ice chest. Each ice chest prepared for shipment will be securely taped shut. Samples will be shipped for overnight delivery to the appropriate laboratory. Samples will be accepted by the contracted laboratories according to their accepted QA manuals and procedures.

3.3.11 EQUIPMENT DECONTAMINATION

Pre-cleaned, disposable (one-time use) sampling equipment will be used where possible to minimize equipment decontamination requirements. Reusable monitoring and sampling equipment such as water level indicators, submersible pumps, and Geoprobe rods and samplers will be decontaminated after sampling at each location in the following manner:

- Wash with low-phosphate detergent (Alconox or equivalent).
- Rinse with potable water.
- Rinse with distilled and deionized water.
- Allow to air dry.

3.3.12 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Field methods have been designed to minimize unnecessary generation of IDW. IDW will consist of expendable sampling supplies, personal protective equipment (PPE), sampling supplies, soil cuttings, and decontamination fluids. Decontamination fluids will be discharged to the ground surface on facility property at a location downgradient of the soil and groundwater sampling locations. Soil cuttings will be returned to the boreholes from which they originated. Disposal of expendable sampling materials and PPE as municipal solid waste will occur off site.

3.3.13 FIELD DOCUMENTATION AND RECORDS

Sampling personnel will maintain a field logbook to record all pertinent activities associated with the sampling events. Appropriate documentation pertaining to photographs taken will also be recorded in the field logbook, along with information pertaining to all samples (such as sampling dates and times, locations, and so on). Labels will be affixed to sample containers—identifying sample numbers, dates and times collected, and requested analyses. COC records will be completed and maintained for all samples from the time of their collection until they are submitted to the laboratory for analysis.

The Tetra Tech Project Manager will provide the most current version of the Work Plan to all appropriate personnel throughout sampling activities. Following field activities, Tetra Tech will prepare a formal report as described in Section 4.1.

Information pertinent to the sampling and measurement program will be recorded in a bound field logbook with consecutively numbered pages. The information will be entered into the field logbook at the time of sampling. At a minimum, the logbook will contain the following:

- Background Information
  - Date and time of the sampling activities
  - Personnel on site
  - Weather conditions
  - Purpose of sampling
- Chronology of Sampling
  - Description of sampling points and sampling methodology
  - Number and volume of samples collected

- Date and time of collection
- Sample identification number
- Field observations about any problems encountered and deviations from the final QAPP

- Sample Distribution
  - Sample distribution and method of transport (name of laboratory where samples were sent, overnight courier service used, airbill number, and other information)
  - Signature of sampler or field sample custodian.

Each page will be dated and signed by the person making the entries. Logbooks are accountable field documents and serve as a chronological representation of the sampling and measurement program. Sufficient detail will be included in the logbook to provide a summary of sampling and measurement activities without relying on the recorder's memory.

3.4 ANALYTICAL METHODS REQUIREMENTS, LABORATORY DOCUMENTATION, AND LABORATORY CORRECTIVE ACTION

The following sections describe analytical method requirements (included required turnaround time), required laboratory documentation, and a description of laboratory corrective action procedures.

3.4.1 ANALYTICAL METHOD REQUIREMENTS

Samples will be analyzed at the contracted laboratory (or laboratories), according to the methods listed in Table 9. Reporting limits should be equal to or less than the appropriate screening levels (see Table 9). All PCB analyses shall determine PCB concentrations as individual PCB congeners. The requested analyses have been selected based on past sampling data and historical information acquired for the site. Laboratory analysis will be performed in accordance with the reference methods, as documented or amended by the laboratories' internal SOPs. Calibration procedures and frequencies will accord with the listed EPA methods. Calibration standards will be prepared from standard reference materials.

Standard turnaround time will be requested for all analyses unless expedited turnaround time is requested by the GSA Project Manager.

3.4.2 LABORATORY DOCUMENTATION

A full data package (Level 4) will be requested from the contracted analytical laboratory. A Level 4 data package includes a detailed case narrative and all summary data sheets and summary QC data sheets, and raw data. At a minimum, the QC data results should include gas chromatograph/mass spectrometer (GC/MS) tuning data, initial and continuing calibration verification data (including response factors, percent relative standard deviation [%RSD] and percent difference [%D]), initial and continuing calibration blank data, surrogate recovery data, internal standard area recovery data, method blank data, matrix spike/matrix spike duplicate (MS/MSD) data, and laboratory control sample (LCS) data. In addition, the laboratory shall provide a summary of all reporting limits and detection limits. Also, relative percent differences (RPD) and percent recoveries (%R) should be calculated for the MS/MSD data, and %Rs should be calculated for the LCS data.

3.4.3 LABORATORY CORRECTIVE ACTION

If an analytical system fails, the contracted laboratory's QA Manager will be notified, and corrective action will be taken. In general, corrective actions will include stopping the analysis, examining instrument performance and sample preparation information, and determining whether instrument recalibration and re-preparation and re-analysis of samples are warranted.

3.5 QUALITY CONTROL REQUIREMENTS

The following sections describe calculation of data quality indicators; QC samples and their acceptance criteria; instrument and equipment testing, maintenance, and calibration; inspection of equipment and supplies; data acquisition requirements; data management; and assessment and response actions.

3.5.1 CALCULATION OF DATA QUALITY INDICATORS

The QA objective for this project is to provide valid data of known and documented quality. Specific data quality objectives are discussed in terms of accuracy, precision, completeness, representativeness, and comparability. This section presents the specific calculations that will be used to describe the following data quality indicators for the analytical data: precision, accuracy, representativeness, and completeness.

Precision

Precision for this project is defined as a measure of agreement among individual measurements of laboratory-prepared duplicate samples and field duplicates. Precision will be estimated by analyzing duplicate MS samples or duplicate samples. The RPD between the analyte levels measured in the MS/MSD samples will be calculated using the following equation:

$$RPD = \{|MS - MSD| / [0.5 * (MS + MSD)]\} * 100$$

The RPD between the analyte levels measured with LCS/LCS duplicate (LCSD) samples will be calculated as:

$$RPD = \{|C_O - C_D| / [0.5 * (C_O + C_D)]\} * 100$$

Where:

C_O = the original sample concentration
C_D = the duplicate sample concentration

Accuracy

For this project, accuracy is defined as the ratio, expressed as a percentage, of a measured value to a true or reference value. The analytical component of accuracy will be expressed as percent recovery, based on the analysis of laboratory-prepared spike samples. Accuracy will be estimated by calculating the percent recovery of laboratory MS/MSD samples using the following equation:

$$\%Rec = [(C_j - C_o) / C_t] * 100$$

Where:

%Rec = Percent recovery
C_j = Measured concentration in spiked sample aliquot
C_o = Measured concentration in unspiked sample aliquot
C_t = Actual concentration of spike added

Percent recovery for LCS/LCSD samples will be calculated using the following equation:

$$\%Rec = [(C_j / C_t] * 100$$

Where:

%Rec = Percent recovery
C_j = Measured concentration in the LCS
C_t = Actual concentration of LCS

Representativeness

Representativeness of collected samples is facilitated by establishing and following criteria and procedures identified in this Work Plan. Representativeness will be reviewed in relation to the sampling design. Field duplicate samples and equipment blanks will also be used to assess representativeness for groundwater samples.

Completeness

Data completeness will be expressed as the percentage of data generated that is considered valid. A completeness goal of 75 percent will be applied to this project; however, if that goal is not met, site decisions may still be made based on the remaining data. No critical samples have been identified for the project. Completeness will be reported as the percentage of measurements judged valid. The following equation will be used to determine completeness:

$$\%C = (V / T) * 100$$

Where:

%C = Percent completeness
V = Number of measurements judged valid
T = Total number of measurements

3.5.2 QUALITY CONTROL SAMPLES

Field QC samples will be collected to help evaluate the validity of data obtained from collected samples. Field QC samples for this project will include field duplicates, trip blanks, and equipment blanks. Table 11 in Appendix B summarizes the types of field QC samples to be collected for the proposed samples. The contract laboratory will also analyze MS/MSD samples.

Specific acceptance criteria related to the QC samples are specified in Table 12. As part of the external data validation conducted by Tetra Tech, the data will be compared to the acceptance criteria listed in Table 12. Data not meeting the acceptance criteria will be flagged, and corrective action will be taken. Corrective action will include evaluating the cause of the failure and may include re-sampling. If the failure is associated with sampling, field procedures will be re-evaluated, with any changes documented in the project report. In addition, data not meeting acceptance criteria will be evaluated during the external data verification/validation process described in Section 4.2, and the reviewer will render an opinion on the usability of the data. This opinion will be included in Tetra Tech's report.

Field Duplicate Samples

Field duplicate samples are two samples collected at the same time and from the same location that are submitted as separate samples (blind) to one laboratory for analysis. Collection and analysis of field duplicates allows evaluation of consistency of the overall sampling and analytical system.

Field duplicate samples will be collected for 5 percent of indoor air, sub-slab vapor (Summa canisters only), and groundwater samples. Duplicate samples will be analyzed for the same parameters as the environmental samples. The sampling locations will be recorded in the field logbook, but duplicates will not be identified by sample labeling. Field duplicates will be collected at randomly selected locations. Analytical results from field duplicate samples will be used to evaluate precision by calculating the RPD.

Significant differences in results from soil duplicate samples are common because of the difficulty of collecting truly homogenous collocated soil samples (EPA 2000a). Likewise, collection of truly homogenous collocated surface dust samples is difficult. For this reason, no field duplicate soil, surface dust, or concrete samples will be collected, and field duplicate RPD thus will not be a critical QA/QC parameter in determining usability of sampling data for these media.

Equipment/Media Blanks

Equipment blank samples are samples of clean, analyte-free water passed through and over the sampling equipment. These blanks permit evaluation of equipment decontamination procedures. One equipment blank will be collected each day non-disposable, non-dedicated Geoprobe sampling equipment is used to collect subsurface soil or groundwater samples. The equipment blank will be collected by pouring deionized water over or through the decontaminated sampling equipment and collecting it in the appropriate sample containers. The blank will be analyzed for the same parameters as the environmental samples.

In lieu of equipment blanks for air and surface dust sampling, media blank samples will be submitted for analysis. If these sampling devices are employed in air or surface dust sampling, the following media blank samples will be submitted for the same analyses as the environmental samples: mini-PUF tube, PUF cartridge, solid Hopcalite sorbent tube, and micro-vac cartridge.

Trip Blanks

Trip blanks are analyzed to estimate incidental or accidental contamination of the environmental samples during sampling, storage, and transportation to the laboratory. A water or soil trip blank will be provided by the analyzing laboratory and will be stored and shipped with each cooler containing soil or groundwater samples to be analyzed for VOCs or TPH GRO. The trip blanks will be analyzed for VOCs. One Summa canister trip blank will also be submitted for analysis.

MS/MSD Samples

MS/MSD samples are analyzed to evaluate the precision and accuracy of an analytical method for a particular environmental sample matrix. The MS sample is prepared by adding a known concentration of target analytes to an aliquot of the field sample. The MS/MSD samples measure the efficiency of all of the steps of the analytical method in recovering target analytes from an environmental sample matrix. MS/MSD samples will be analyzed for the same parameters as the environmental samples. Samples for MS/MSD analysis will be collected at locations to be selected in the field. If the results of MS/MSD analyses indicate that the percent recoveries or RPD are outside established acceptance limits, appropriate laboratory and data validation protocols specific to the method will be followed to evaluate the usability of the data. Tetra Tech will coordinate with the analytical laboratory to determine if extra sample volumes will be required to conduct the MS/MSD analyses.

3.5.3 INSTRUMENTS, EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Sampling personnel will test, inspect, and maintain all sampling equipment and supplies prior to deployment for field activities. Testing, inspection, and maintenance of field equipment and analytical instrumentation will be performed in accordance with manufacturers' recommendations.

3.5.4 CALIBRATION OF INSTRUMENTS AND FREQUENCY

This section describes the procedures for maintaining the accuracy of field equipment and laboratory instruments used for field tests and laboratory analyses.

Field Equipment

Equipment used to collect field samples or take field measurements will be maintained and calibrated with sufficient frequency and in such a manner that the accuracy and reproducibility of results are consistent with the manufacturer's specifications. The Tetra Tech FTL is responsible for verifying that field sampling and measurement equipment is in good working condition, and for documenting and maintaining records of calibration. Analytical field instruments required for sampling and required methods for calibrating these instruments are described in Table 9.

Laboratory Instruments

Calibration of laboratory analytical instrumentation will be in accordance with the referenced methods and manufacturers' recommendations. Calibration records (including dates and times of calibration, and names of personnel performing the calibration) will be filed at the location where the analytical work is performed; these records will be maintained by the laboratory personnel performing QC activities.

3.5.5 INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

All sample containers will meet EPA criteria for cleaning procedures required for low-level chemical analysis. Sample containers will have Level II certifications provided by the manufacturer in accordance with pre-cleaning criteria established by EPA in *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers* (EPA 1992). The Tetra Tech Project Manager is responsible for ensuring the sampling containers meet these requirements.

3.5.6 DATA ACQUISITION REQUIREMENTS

Previous data and information pertaining to the site are available from various sources (including other analytical data, reports, photographs, and maps referenced in this Work Plan). Some of those data have not been verified; however, that unverified information will not be used for decision-making purposes without verification of its authenticity.

3.5.7 DATA MANAGEMENT

All laboratory data acquired during this activity will be managed in accordance with the QA manuals and procedures of the contracted laboratories.

Records produced during field activities will include field data acquisition sheets, COC records, airbills, communication logs, documentation of corrective actions, documentation of deviation from sampling methods, identification of QC samples, meteorological data from the field, documentation of sampling equipment decontamination, documentation of instrument calibration, sampling locations, sampling notes, and drilling logs. Records produced in the field will be retained with the project file. A copy of all field notes and field sheets will be included in the appropriate project report.

Laboratory data and data obtained in the field will be reduced and used to prepare project reports as described in Section 4.1. Example field sheets, COC form, and figure and table summarizing analytical data are in Appendix C.

3.5.8 ASSESSMENTS AND RESPONSE ACTIONS

Assessment and response actions pertaining to analytical phases of the project are addressed in QA manuals and procedures of the contracted laboratories. Corrective action will be taken at the discretion of the GSA and Tetra Tech Project Managers whenever problems appear that could adversely affect data quality or resulting decisions affecting future response actions.

The Tetra Tech QA Manager is responsible for monitoring the quality of work performed and technical documents generated by the Tetra Tech team. Specific Tetra Tech QA Manager responsibilities are described in Section 1.3.4.

4.0 DATA REDUCTION, VALIDATION, AND REPORTING

The following sections describe reports to management; data review, validation, and verification requirements; validation and verification methods; and reconciliation with user requirements.

4.1 REPORTS TO MANAGEMENT

Tetra Tech will prepare a formal Occupational Exposure Evaluation report describing sampling techniques, locations, and problems encountered (with resolutions to those problems), and interpretation of analytical results following completion of the field activities described herein. The laboratory data will be compared to all applicable or relevant and appropriate requirements to determine whether further response is warranted. The formal report will include copies of Tetra Tech's field notes, site maps, photographs, analytical data, and COC records, as well as a data validation and usability report prepared by Tetra Tech. The Tetra Tech Project Manager is responsible for preparing this report and will deliver the report to the GSA Project Manager.

4.2 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Data review and verification will be performed by a qualified laboratory analyst and the laboratory's section manager, in accordance with the laboratory's QA program.

A Tetra Tech chemist will conduct an external verification and validation of the laboratory data package using a method described in Section 4.3. The verification and validation will also include comparing the analytical data to the acceptance criteria listed in Table 12 (see Appendix B).

The Tetra Tech QA Manager will review the project report to ensure that all field data reduction and review procedures and requirements were followed.

When issues are identified during data review, corrective action will primarily consist of investigating the circumstances and cause of the failure, evaluating the usefulness of the data, and reporting these findings to the data users. The Tetra Tech QA Manager will be responsible for initiating any corrective action when problems are identified during data review.

4.3 VALIDATION AND VERIFICATION METHODS

The analytical data package will be validated internally by the contracted laboratory in accordance with the laboratory's established SOPs. A Tetra Tech chemist will conduct an external verification and validation of the laboratory data package using a method consistent with a Stage 2B validation, as described in the EPA Contract Laboratory Program (CLP) *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA 2009). A Stage 2B validation includes verification and validation based on completeness and compliance check of sample receipt conditions and sample-related and instrument-related QC results.

4.4 RECONCILIATION WITH USER REQUIREMENTS

If any problems with field measurements or analytical data are identified by Tetra Tech's field oversight or data verification/validation, Tetra Tech will explain the circumstances of the failure, describe any corrective action taken, and provide an opinion on the limitations and usefulness of the data in the Field Oversight and Data Verification and Validation Report.

5.0 REFERENCES

ASTM International (ASTM).

2011. *Standard Practice for Collection of Surface Dust by Micro-vacuum Sampling for Subsequent Metals Determination.* D7144-05a. On-line address: http://www.astm.org/Standards/D7144.htm.

Code of Federal Regulations (CFR).

2011. Title 40 – *Protection of Environment*, Part 761 – *Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*, Subpart G – *PCB Spill Cleanup Policy*. On-line address: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=704f26708a5fe8890a76c2c3f1332164&rgn=div8&view=text&node=40:31.0.1.1.18.7.1.2&idno=40.

National Institute for Occupational Safety and Health (NIOSH)

2003. Method 7300 – *Elements by ICP*. March 15. On-line address: http://www.cdc.gov/niosh/docs/2003-154/pdfs/7300.pdf.

U.S. Environmental Protection Agency (EPA).

1992. *Specifications and Guidelines for Obtaining Contaminant-Free Sample Containers.* December. On-line address: http://nepis.epa.gov/Exe/ZyNET.exe/

1994. Environmental Response Team (ERT) Standard Operating Procedure (SOP) 2119: *Air Sampling For Metals (NIOSH Method 7300, Elements).* October 7. On-line address: http://www.ert.org/products/2119.PDF

1995. ERT SOP 2007: *Groundwater Well Sampling*. January 26. On-line address: http://www.ert.org/products/2007.PDF.

1996. Method 5035: *Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples.* December. On-line address: http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/5035.pdf.

1999a. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition.* EPA/625/R-96/010b. January. On-line address: http://www.epa.gov/ttnamti1/files/ambient/airtox/tocomp99.pdf .

1999b ERT SOP 1827: *Analysis of Mercury in Air with a Modified NIOSH 6009 Method.* May 13. On-line address: http://www.ert.org/products/mercury_response_guide/AttachmentD.pdf.

2000a. *Data Quality Objectives Process for Hazardous Waste Site Investigations.* EPA QA/G-4HW, Final. January. On-line address: http://www.epa.gov/quality/qs-docs/g4hw-final.pdf.

2000b. ERT SOP 2012: *Soil Sampling*. February 18. On-line address: http://www.ert.org/products/2012.pdf.

2002a. *Draft SOP for Installation of Sub-Slab Vapor Probes and Sampling Using EPA Method TO-15 to Support Vapor Intrusion Investigations*. On-line address: http://www.epa.gov/region8/r8risk/pdf/epa_sub-slabvapor.pdf.

2002b. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.* November. On-line address: http://www.epa.gov/osw/hazard/correctiveaction/eis/vapor/complete.pdf.

2004. *Polychlorinated Biphenyl Inspection Manual*. August. On-line address: http://www.epa.gov/compliance/resources/publications/monitoring/tsca/manuals/pcbinspect/index.html.

2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. Office of Solid Waste and Emergency Response (OSWER) No. 9200.1-85 EPA 540-R-08-005. January 13. On-line address: http://www.epa.gov/superfund/policy/pdfs/EPA-540-R-08-005.pdf.