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ATTACHMENTS

LIST OF ABBREVIATIONS AND ACRONYMS

ANSI ..... American National Standards Institute
AOC ..... Area of Concern
ARI ..... Analytical Resources, Inc.
ASQC ..... American Society of Quality Control
Boeing ..... The Boeing Company
CLP ..... Contract Laboratory Program
COC ..... chain of custody
DQI ..... data quality indicator
DQO ..... data quality objective
Ecology ..... Washington State Department of Ecology
EDD ..... electronic data deliverable
EPA ..... US Environmental Protection Agency
EQuIS ..... Environmental Quality Information Systems
eV ..... electron volt
ft ..... feet, foot
HASP ..... health and safety plan
HAZWOPER ..... Hazardous Waste Operations and Emergency Response
LAI ..... Landau Associates, Inc.
LCS ..... laboratory control sample
LCSD ..... laboratory control sample duplicate
LDW ..... Lower Duwamish Waterway
MDL ..... method detection limit
MQO ..... measurement quality objective
MS ..... matrix spike
MSD ..... matrix spike duplicate
PAH ..... polycyclic aromatic hydrocarbon
PCB ..... polychlorinated biphenyl
PCOC ..... potential contaminant of concern
PID ..... photoionization detector
PQL ..... practical quantitation limit
QA ..... quality assurance
QAPP ..... quality assurance project plan
QC ..... quality control
RI ..... remedial investigation
RPD ..... relative percent difference
SAP ..... sampling and analysis plan
Site ..... Boeing Developmental Center
SL ..... screening level

LIST OF ABBREVIATIONS AND ACRONYMS (CONT'D)

SOPs ..... standard operating procedures
SWMU ..... Solid Waste Management Unit
TPH ..... total petroleum hydrocarbons
VOC ..... volatile organic compound
WAC ..... Washington Administrative Code

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) establishes the quality assurance (QA) objectives for the remedial investigation (RI) being conducted at The Boeing Company (Boeing) Developmental Center (Site) located in Tukwila, Washington (Figures B-1 and B-2). This plan presents the quality control (QC) procedures developed to meet project QA objectives.

1.1 Distribution List

The following list identifies those individuals to receive an electronic copy of the approved QAPP, as well as any subsequent revised versions of the documentation:

- Christa Colouzis—Project Manager for the Washington State Department of Ecology (Ecology) (cboe461@ecy.wa.gov)
- Lindsey Erickson—Project Manager for Boeing (lindsey.e.erickson@boeing.com)
- Ken Reid—Consultant (Landau Associates, Inc. [LAI]) Project Manager (kreid@landauinc.com)
- Danille Jorgensen—Consultant (LAI) Quality Assurance Officer (djorgensen@landauinc.com)
- Kelly Bottem—Project Coordinator for Analytical Resources, Inc. (ARI) (Kelly.bottem@arilabs.com).

1.2 Project Organization

Site RI activities will be implemented by Boeing; Lindsey Erickson is the project manager. LAI is responsible for preparing documents associated with the planned RI activities, implementing the activities, and reporting the RI results to Boeing. Ken Reid is the LAI RI project manager and will communicate directly with Lindsey Erickson, as necessary, during the course of RI activities. Mr. Reid will be responsible for implementing and executing the technical, QA, and administrative aspects of the RI and will manage LAI staff working on this project. Danille Jorgensen, the designated LAI Quality Assurance officer, is responsible for the overall management of the project-specific QA and QC requirements, including field and laboratory QC. LAI's staff managing field operations will report field progress and problems to Mr. Reid on a daily basis and will be responsible for managing subcontractors, as necessary, that support RI activities at the Site. Christine Kimmel is the designated Health and Safety Manager for field activities.

Specific QA responsibilities for this project are listed in Table B-1. The QA manager will be responsible for QA oversight during investigation activities including sampling events, analytical laboratory coordination, and direct implementation of this QAPP. The QA manager will be responsible for overseeing data validation and for confirming that the QA objectives of the project are met.

2.0 PROJECT BACKGROUND / DESCRIPTION

The Site is located at 9725 East Marginal Way South in Tukwila, Washington near Boeing Field and the Military Flight Center (now called the Military Delivery Center). The Site is bounded by the Lower Duwamish Waterway (LDW) on the west and south, and by East Marginal Way South on the east and the Museum of Flight and Slip 6 on the north. The Site is at an average elevation of approximately 20 feet (ft) above mean sea level. Surface topography at and in the vicinity of the Site is generally flat. The Site and surrounding area is paved.

The Site is an aircraft and aerospace research and development complex, primarily supporting projects for the US Department of Defense. The facility currently consists of more than 30 buildings on approximately 112 acres. It continues to be the primary research and development center for carbon fiber composite structures.

Various existing information evaluations, environmental investigations, and remedial actions have been conducted at the Site to characterize and evaluate the chemical quality and physical condition of soil, groundwater, air, and sediment, or to address specific releases. Descriptions of previous activities are provided in the text of the RI work plan.

2.1 Project Goals and Objectives

This QAPP has been prepared to cover work related to the RI. The specifics of the RI investigation are presented in the RI work plan published concurrently with this QAPP.

The purpose of this QAPP is to provide specific QA and QC procedures to ensure that sample collection, handling, and analysis will result in data of sufficient quality to plan and evaluate remedial actions at this site. These QA and QC procedures will support the evaluation and interpretation of data determined to be of acceptable quality and completeness. This QAPP has been prepared based on the requirements outlined in the US Environmental Protection Agency's (EPA's) Guidance for Quality Assurance Project Plans (EPA 2002), EPA's Requirements for Quality Assurance Project Plans (EPA 2001), and Ecology's Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology 2016).

Commented [A1]: Text added per Ecology comment #29.

To the extent possible, the procedures included in this QAPP have been standardized to support effective evaluation of data resulting from sampling of the various media that has the potential to be evaluated at the Site. In the event that additional investigation activities are performed following the publication of this QAPP (i.e., additional activities not addressed in the RI work plan), work plan addenda will be prepared to document data quality objectives and sampling, and will include any revisions to screening levels (SLs), practical quantitation limits (PQLs), sampling procedures, and laboratories, as needed.

ARI in Tukwila, Washington is the laboratory to be used for planned RI activities. Analytical testing will be in accordance with the methodologies established by the EPA (EPA 1983, 1999) and Standard Methods for the Examination of Water and Wastewater, 20th edition (APHA 1998). The EPA compendium of test methods (SW-846) provides for the analytical procedures to be used as well as the specific application of those procedures. Laboratory standard operating procedures (SOPs) are provided in Attachment B-1.

3.0 QUALITY ASSURANCE OBJECTIVES

This section presents the QA and QC objectives and processes including data quality objectives (DQOs), data quality indicators (DQIs), measurement quality objectives (MQOs), and QC procedures for field and laboratory work.

3.1 Data Quality Objectives

DQOs specify the environmental decisions that the data will support and the corresponding level of data quality required to ensure decisions are based on sound scientific data. The DQOs for this project are summarized below:

- Obtain data that are representative of Site conditions
- Characterize concentrations of potential contaminants of concern (PCOCs) in soil and groundwater, which may include volatile organic compounds (VOCs); gasoline-, diesel-, and oil-range total petroleum hydrocarbons (TPH); polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs); total and/or dissolved metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, and/or zinc)
- Obtain data that are comparable to applicable screening criteria

3.2 Data Quality Indicators

DQIs are used to establish DQOs and are discussed in detail below. A summary of DQIs and their associated MQOs are presented by sample matrix in Table B-2.

3.2.1 Precision

Precision is a measure of variability in the results of replicate measurements due to random error (Ecology 2016). Precision is best expressed in terms of the standard deviation or relative percent difference (RPD). QC sample types that can be used to evaluate precision include field and laboratory duplicates, matrix spike duplicates (MSDs), and laboratory control sample duplicates (LCSDs). The precision of duplicate measurements will be expressed as an RPD, which is calculated by dividing the absolute value of the difference of the two measurements by the average of the two measurements, and expressing it as a percentage. The formula for RPD calculation is shown below:

$$\text{RPD} = \left[\frac{|\text{D1} - \text{D2}|}{[(\text{D1} + \text{D2}) \div 2]}\right] \times 100\%$$

Where:

D1 = first measurement value

D2 = second measurement value (duplicate).

3.2.2 Accuracy

Accuracy is a combination of precision and bias (described in Section 3.2.7), in that it represents the degree to which a measured value represents the known value (Ecology 2016). Accuracy is expressed as the percent recovery of spiked samples (matrix spike [MS], laboratory control sample [LCS], and surrogate spike). The general formula used to calculate percent recovery is shown below (for MS/MSD percent recovery, the result from the unspiked sample is taken into account in the formula):

$$\%R = \left[\frac{SSR}{C_s}\right] \times 100\%$$

Where:

%R = percent recovery

SSR = spiked sample result

C_s = concentration of the spike added.

3.2.3 Representativeness

Representativeness is an indicator of how accurately a result reflects the desired characteristic(s) of a defined population, accounting for both temporal and spatial variability (Ecology 2016). Representativeness qualitatively describes how well the analytical data characterize an area of concern. Representativeness is largely determined by the sampling design; analytical parameters for use in its evaluation include method-specified holding times and preservation requirements, and matrix heterogeneity. The sampling design for this project is discussed in the RI work plan.

3.2.4 Comparability

Comparability is the "degree of confidence with which one data set can be compared to another" (Ecology 2016). QC procedures and MQOs, as stated in this QAPP, will provide for measurements that are consistent and representative of the media and conditions measured.

3.2.5 Completeness

Completeness is a measure of "the amount of valid data obtained from a measurement system compared to the amount that could be expected to be obtained under normal conditions" (EPA 2009). Field completeness is calculated as the number of actual samples collected divided by the number of planned samples. Analytical completeness is calculated as the number of valid data points divided by the total number of data points requested. Data points are considered invalid if they are rejected during data validation. The data validation approach for this project is provided in Section 6.0. The requirements for field sampling and analytical completeness are 90 percent each.

3.2.6 Sensitivity

Sensitivity is the capability of a method or an instrument to discern the difference between very small amounts of a substance. For the purposes of this project, sensitivity is the lowest concentration that can be accurately detected by the analytical method, which is defined by the laboratory as the PQL. The analytical method will be considered sufficiently sensitive if the PQLs are below the specific SLs for the area under investigation. Proposed method and target PQLs are presented in Table B-3.

3.2.7 Bias

Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias of the laboratory results will be evaluated based on analysis of reference materials, method blanks, and MS samples, as described in Section 6.5.

4.0 SPECIAL TRAINING / CERTIFICATION

Personnel performing onsite investigation tasks will have completed formal 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) health and safety training, in compliance with 29 Code of Federal Regulations 1910.120 and Chapter 296 of the Washington Administrative Code (WAC). Certificates of successful completion of training, which will be maintained in personnel health and safety files, will verify on-the-job training for those tasks staff are assigned to perform. At least one member of each field team and the designated site safety officer will be trained in cardiopulmonary resuscitation and first aid.

Borings will be completed and monitoring wells will be constructed by a licensed drilling contractor in the state of Washington, following Washington State well standards. Oversight of drilling and well installation activities will be performed by an environmental professional familiar with environmental sampling and construction of resource protection wells.

As indicated in Section 2.1, ARI in Tukwila, Washington is the laboratory to be used for planned RI activities. This laboratory is not in the Contract Laboratory Program (CLP), but is accredited through Ecology for the applicable methods and target analytes listed in this QAPP. All laboratories shall maintain current applicable state certification or US Department of Defense Environmental Laboratory Accreditation Program certification for the methods and target analytes listed in this QAPP while performing analyses for the project. Laboratories used for this project have a documented QA program that complies with standards promulgated by the American National Standards Institute/American Society of Quality Control (ANSI/ASQC 1994); ANSI's Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs (Johnson 1994); and the EPA's Requirements for Quality Assurance Project Plans (EPA 2001).

Excavation, trenching, and shoring (WAC 296-155-Part N) activities or work in confined spaces (WAC 296-62-Part M) are not anticipated in this scope of work; therefore, this QAPP does not address training in physical worker safety issues that may be associated with excavation or confined spaces.

5.0 DOCUMENTS AND RECORDS

This section describes the management requirements for production, distribution, and storage of documents and records associated with planned activities at the Site.

5.1 Document Distribution

Prior to beginning field activities, field staff will receive and have an opportunity to review project-related documents pertinent to the field activities, including work plans, sampling and analysis plans (SAPs), and health and safety plans (HASPs), as appropriate to the planned activities. Project managers/coordinators will meet with field staff prior to field activities to review the relevant plans accordingly. The HASP will be reviewed in the field on the first day of activities, with each field person documenting their attendance to the HASP review on a sign-in sheet. The HASP will be reviewed again every few days or when a new field person begins working on field activities. The SAP, HASP, and work plans for each phase of the project will be finalized prior to commencement of field activities, and only the finalized versions will be distributed to field staff. Changes to procedures and plans after finalization will be documented as addenda and distributed along with the original finalized versions.

5.2 Field Documentation

Field equipment will have reference and related manuals stored in with the equipment. In addition, equipment that requires calibration will be accompanied by a calibration logbook. Field staff will record the calibration process in the logbook every time a calibration is performed.

A complete record of field activities will be maintained for the duration of the field phase of the work. Documentation will include the following:

- Daily recordkeeping by field personnel of field activities
- Recordkeeping of samples collected for analysis (field sampling forms)
- Use of sample labels and tracking forms for samples collected for analysis.

The field logs will provide a description of sampling activities completed, sampling personnel, daily weather conditions, and a record of modifications to the procedures and plans identified in the work plan or related documentation. The field logs are intended to provide sufficient data and observations to enable project staff to reconstruct events that occurred during the sampling period.

Field logs will be supplemented by sample collection forms, boring logs, and groundwater well logs completed by field staff, as applicable. The information that will be recorded in these forms is specified in the RI SAP.

Additional records associated with drilling will include driller's daily reports and well-related documentation when a well is installed.

Sample possession and handling will also be documented with chain-of-custody (COC) forms so that it is traceable from the time of sample processing in the field, to delivery to the laboratory, and to the ultimate data analysis. Sample handling and COC procedures are described in Section 6.3.

The following example field forms are provided in Attachment B-2:

- Chain-of-Custody
- Field Report
- Groundwater Low-Flow Sample Collection Form
- Log of Exploration
- Soil/Sediment Sample Collection Form
- Survey Field Notes Form
- As-Built Well Completion Form
- Well Development Record Form
- Seep Reconnaissance Survey Form.

5.3 Analytical Data Records

Laboratory analytical data reports will be provided in electronic format by the laboratory. These reports will be included as appendices in documents where data are reported, and will be kept along with all other documents in the project files. Data will be provided in a Level II laboratory report format. Data package elements are listed in Section 6.7.

5.4 Storage

Documents and records associated with the project (i.e., final documents, billing, and invoice records) and the documents described in Sections 5.2 and 5.3 will be stored in electronic form in project files on LAI's servers for the duration of the project and 10 years subsequent from the date of completion of work, as per the requirements in the associated Agreed Order (No. DE 16275).

6.0 DATA GENERATION AND ACQUISITION

This section provides an overview of the data collecting and handling processes that will ensure data quality that meets project standards. More details about these processes are included in the RI SAP.

6.1 Sampling Process Design

A sampling design that achieves the DQOs described in Section 3.0 has been prepared and is detailed in the RI SAP.

6.2 Sampling Methods and Containers

Samples will be collected using methods that are standard in environmental remediation. A detailed description of the sampling methods for each medium is provided in the RI SAP. Methods for sampling, decontamination, and well installation are provided in the RI work plan and Sampling and Analysis Plan, published concurrently with this QAPP.

Sampling containers will be provided by the laboratory. Extra containers will be requested to ensure that clean containers are available to replace any broken or misused containers during sampling events. The laboratory will provide kits (e.g., plunger for EPA Method 5035 soil sampling) to collect samples for analyses that require special methods to fill the sample container.

6.3 Sample Handling and Custody

Soil and water samples submitted to the analytical laboratory will be collected in the appropriate sample containers and preserved as specified in Table B-4. The storage temperatures and maximum holding times for physical/chemical analyses are also provided in Table B-4.

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to release of samples. Samples will be logged on a COC form (Attachment B-2) and will be kept in coolers on ice until delivery to the analytical laboratory. The COC will accompany each shipment of samples to the laboratory. A sample is in custody if at least one of the following is true:

- It is in someone's physical possession.
- It is in someone's view.
- It is secured in a locked container or otherwise sealed so that tampering will be evident.
- It is kept in a secured area, restricted to authorized personnel only.

Sample control and COC protocols in the field and during transport to the laboratory will be conducted in general conformance with the procedures described below:

- As few persons as possible will handle samples.

- Sample bottles will be obtained new or pre-cleaned from the laboratory performing the analyses.
- The sample collector will be personally responsible for the completion of the COC record and the care and custody of samples collected until they are transferred to another person or dispatched properly under COC rules.
- The onsite team leader will oversee implementation of the field custody procedures during the field work and, in the event of non-compliance, will determine if corrective action is required.
- The coolers in which the samples are shipped will be accompanied by the COC record identifying their contents. The original record and laboratory copy will accompany the shipment (sealed inside the shipping container). The other copy will be distributed as appropriate to LAI's QA officer or designee. The QA officer for this project is Danille Jorgensen.
- Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "remarks" section of the COC record.
- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, a bill of lading will be used. Freight bills, postal services receipts, and bills of lading will be retained as part of the permanent documentation.

When samples are transferred, the individuals relinquishing and receiving the samples will sign the COC form and record the date and time of transfer. The sample collector will sign the form in the first signature space. The only exception to this is the shipment of samples via commercial carriers. Because sample containers are sealed with the COC record inside prior to delivery to the carrier, the custody signature will be that of the individual taking possession of the samples from the carrier at its final destination. Each person taking custody will observe whether the shipping container is correctly sealed and in the same condition as noted by the previous custodian; deviations will be noted on the appropriate section of the COC record.

A designated sample custodian at the laboratory will accept custody of the shipped samples, verify the integrity of the custody seals, and certify that the sample identification numbers match those on the COC record. The custodian will then enter sample identification number data into a bound logbook, which is arranged by a project code and station number. If containers arrive with broken custody seals, the laboratory will note this on the COC record and immediately notify the sampler who will, in turn, notify the QA manager and the LAI project manager.

6.4 Analytical Methods

Laboratory methods and target PQLs for all potential analyses of soil and water are summarized in Table B-3. Samples collected and analyzed as part of the RI will be reported to the PQL, and in those instances when the PQL is greater than the SL, the SL will be raised to the PQL.

For all groundwater analyses except dissolved metals, suspended material in the sample may be allowed to settle prior to analysis of the supernatant. For the dissolved metals analyses, the samples will be filtered in the field to remove any suspended material.

Sample containers, preservation, and holding times are provided in Table B-4.

6.5 Quality Control

Field and analytical laboratory control samples will be collected and analyzed to evaluate data precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity of the analytical results for this investigation. The quality control samples and the frequency at which they will be collected and/or analyzed by matrix and analysis is summarized in Table B-2. The evaluation of these quality control samples is further discussed in Section 8.

6.6 Instrument/Equipment/Consumables

To ensure that field measurement is accomplished accurately, field equipment undergoes routine maintenance and calibration as described below.

6.6.1 Testing, Inspection, and Maintenance

LAI performs routine inspections and preventive maintenance (parts replacement and cleaning) for all pieces of field equipment in our supply and equipment room. Maintenance activities are conducted by our field technicians, who are specifically trained in the use, operation, and maintenance of the equipment. All field equipment used during this project, which may include water level indicators, photoionization detectors (PIDs), and water field parameter meters (e.g., pH), will be cleaned and decontaminated prior to use. Each piece of equipment will be inspected and tested to ensure proper working function and facilitate replacement or repair of broken or non-operational components. Extra batteries will be included in the equipment cases or in field vehicles for replacing dead batteries during field work. Extra disposables will be packed for equipment requiring disposables for use, such as ferrous iron kits.

Field equipment is maintained by the field equipment manager. Field staff continually notify the field equipment manager when equipment maintenance is needed. This system ensures the equipment is maintained and working for the next field project. Equipment will be repaired or replaced, as needed.

Meters used to make field measurements will be further inspected and tested during calibration, as described in the next section.

6.6.2 Calibration and Frequency

All field equipment is calibrated according to the manufacturers' guidelines and recommendations. If a PID is used during this project, it will be calibrated on a daily basis according to the manufacturer's specifications. The PID preferred by LAI field personnel uses a 10.2-eV (electron volt) probe and is

calibrated using a manufacturer-supplied standard gas (isobutylene, equivalent to 34 parts per million benzene). Similarly, water field parameter meters will be calibrated at the start of each sampling day with laboratory-prepared calibration standards within the range of the anticipated measurement. An instrument will also be recalibrated at any time an anomalous reading suggests instrument imprecision or inaccuracy.

6.6.3 Inspection/Acceptance of Supplies and Consumables

Supplies are ordered and maintained by the field equipment manager. Disposables and consumables include nitrile gloves, Ziploc® bags for sample ice, field test kits, and polyethylene tubing.

6.7 Data Management

All laboratory analytical results (including split sample analytical results; see Section 4.0 of SAP), including QC data, will be submitted electronically. Electronic formats will include a PDF file of the laboratory report, and electronic data deliverable (EDD) files that will be uploaded directly to an Environmental Quality Information Systems (EQuIS) database; the data management team will supply the required format for the EDDs. EQuIS EDDs will be provided by the laboratory in the EFWEDD format (also known as EQuIS 4-File), using LAI valid values. After validation of the data, any applicable qualifiers will be added to the database. Split sample data validation is the responsibility of Ecology.

Field data (groundwater field parameter data and water levels measurements) will be entered into cumulative Excel® spreadsheets and/or the EQuIS database. Data will be verified to determine all entered data are correct and without omissions and errors.

Field notes, including field reports, sampling forms, survey forms, test pit logs, boring logs, and well construction diagrams, will be maintained in the project files. Survey notes will be reduced to provide coordinates and elevations that will be uploaded to the database.

Level II laboratory reports will include the following:

- Case narrative, including adherence to prescribed protocols, non-conformity events, corrective measures, and/or data deficiencies (including initial and continuing instrument calibrations, and explanations for any missed target PQLs)
- Sample analytical results
- Surrogate recoveries
- Matrix spike/matrix spike duplicate results
- Blank spike/blank spike duplicate results
- Laboratory duplicates
- Blank results
- Sample custody (including signed COC records, and laboratory sample receipt forms)
- Analytical responsibility.

7.0 ASSESSMENT AND OVERSIGHT

This section describes assessment and oversight.

7.1 Assessment and Response Actions

Assessments during implementation of the project will include daily communication and updates during field work and data quality review by the LAI project manager and field staff. Response actions to assessed issues will be coordinated between the LAI project manager, field staff, the project manager for Boeing, and involved subcontractors, as appropriate. Data management assessment activities are discussed in greater detail in Section 8.2.4.

If any project non-conformance is considered significant or requires special expertise, corrective action(s) may include the following:

- Reanalyzing the samples, if holding times can be met
- Resampling and analyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data and acknowledging the level of uncertainty or inaccuracy by flagging the data.

8.0 DATA VALIDATION AND USABILITY

This section describes data validation and usability.

8.1 Data Review, Verification, and Validation

All RI data (including split sample analytical results; see Section 4.0 of SAP) will be verified and validated to determine that the results are acceptable and meet the quality objectives described in Section 3.

Validation of the data will be performed by a data validator with guidance from applicable portions of the National Functional Guidelines for Organic Data Review (EPA 2016b) and the National Functional Guidelines for Inorganic Data Review (EPA 2016a).

All data generated as part of the RI will undergo a Level IIA verification and validation, with the exception of samples analyzed for PCB Congeners by EPA Method 1668C. Validation of all data associated with the split samples is the responsibility of Ecology.

Commented [A2]: Footnote added to Table B-4, per Ecology Comment #27.

EPA Level IIA-equivalent verification and validation elements are presented in Table B-5 and will include the following:

- Verification that the laboratory data package contains all necessary documentation (including COC records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related QC data, and QC acceptance criteria)
- Verification that all requested analyses, special cleanups, and special handling methods were conducted
- Verification that QC samples were analyzed per the method and frequency specified in the QAPP
- Evaluation of sample holding times
- Evaluation of QC data compared to acceptance criteria, including field QC samples (field duplicates, trip blanks, and/or equipment blanks) and laboratory QC samples (method blanks, surrogate recoveries, laboratory duplicate and/or replicate results, and LCS results)
- Verification that PQLs for target analytes are at or below the target PQLs specified in the QAPP.

PCB Congener data (EPA Method 1668C) will undergo a Level IV verification and validation, as specified in EPA's Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA 2009).

Commented [A3]: Footnote added to Table B-4, per Ecology Comment #27.

1668C data validated by Level IV, per Ecology Comment #31. Ecology will validate 1668 data.

In the event that a portion of the data is outside the DQO limits or the EPA guidance (EPA 2016a, b), or sample collection and/or documentation practices are deficient, corrective action(s) will be initiated. Corrective action, as described in Section 7.1, may include any of the following:

- Rejection of the data and resampling
- Qualification of the data
- Modified field and/or laboratory procedures.

8.2 Verification and Validation Methods

The processes that will be used to verify and validate data are described in the sections below.

8.2.1 Data Verification Methods

This section describes data verification methods.

8.2.1.1 Chain of Custody

COC forms will be reviewed by field personnel upon completion of sampling, who will verify information against the packed sample coolers they represent. A copy of the COC form will be retained in the electronic project files, and the original and remaining copies will be taped inside the cooler for delivery to the analytical laboratory.

8.2.1.2 Corrective Actions

The corrective action process may be initiated by any project team member. The process consists of identifying a problem, acting to eliminate the problem, documenting the corrective action, monitoring the effectiveness of the corrective action, and verifying that the problem has been sufficiently addressed. The LAI field lead will be responsible for correcting and resolving situations in the field that may result in non-compliance with the QAPP. Corrective measures identified by the field lead will be immediately documented in the field notes. Examples of corrective actions for field measurements may include: repetition of a measurement to check the error, check for proper adjustments for ambient conditions, check of batteries, recalibration, replacement of instruments, revisions to COCs forms, and (if necessary) stop work. Laboratory project managers are responsible for ensuring that corrective action processes as identified in their quality systems manuals, SOPs, and this QAPP are followed. The laboratory project manager is responsible for notifying the LAI QA manager of any non-conformance. If a corrective action is initiated at the laboratory, it shall be narrated in the laboratory data package. Technical staff will be responsible for reporting any QA non-conformance or suspected deficiencies they identify to the LAI project manager, who will in turn notify the LAI QA manager. The LAI QA manager is responsible for assessing the suspected deficiency or non-conformance and its potential to impact data quality.

If corrective actions are required, a copy of the documented corrective action taken will be maintained in the electronic project files. At the completion of the sampling event, the LAI QA officer

and the LAI project manager will ensure all appropriate corrective actions have been taken and that the corrective action reports have been included in the electronic project files; if corrective actions have not been taken, the project manager will ensure action is taken.

8.2.1.3 Field Notes

Field notes will be reviewed internally and placed in the electronic project files.

8.2.1.4 Analytical Data Packages

All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.

All laboratory data packages, with the exception of waste characterization samples, will be verified by a data validator who is not associated with the collection or analysis of samples, interpretation of sample data, or with any decision-making process within the scope of the investigation.

The data validator will conduct an EPA Level IIA-equivalent validation and verification, which will be performed with guidance from applicable portions of the National Functional Guidelines for Organic Data Review (EPA 2016b) and the National Functional Guidelines for Inorganic Data Review (EPA 2016a). Additional information regarding the data validation process is provided in the following sections.

8.2.2 Data Validation Methods

Validation of the analytical data will include the criteria listed below. Validation procedures will be followed to ensure data are evaluated properly, completely, and consistently for use in meeting DQOs.

The data validator (unless noted otherwise) will complete the following:

- Data deliverables: Ensure all required verified information on sampling and analysis has been made available as part of data validation (see Section 8.2.1; this also includes associated planning documents [i.e., work plan, SAP, or QAPP]).
- Analytes: Ensure the required list of analytes was reported as specified in the planning documents.
- COC: Review the COC form for traceability of the data from sample collection through to data reporting.
- Holding times: Ensure samples were analyzed within specified holding times (i.e., method, procedure, or planning document). If holding times were not met, confirm the laboratory has documented any deviations and made appropriate notifications to the project team, and that approval to proceed was received prior to analysis.
- Sample handling: Ensure sample handling, receipt, and storage procedures were followed, with any deviations documented.

- Sampling methods and procedures: Establish that required sampling methods were used and any deviations documented. Ensure the sampling procedures and field measurements met performance criteria and any deviations were documented.
- Field transcription: Authenticate transcription accuracy of field data (i.e., from field forms to report tables).
- Analytical methods and procedures: Establish that required analytical methods were used, with any deviations documented. Ensure QC samples met performance criteria, with any deviations documented.
- Data qualifiers: Determine laboratory data qualifiers were defined and applied as specified (i.e., method, procedure, or planning document).
- Laboratory transcription: Authenticate accuracy of transcription of analytical data (i.e., instrument to the Laboratory Information Management System, or laboratory notebook to reporting form).
- Standards: Determine that standards are traceable and meet requirements (method, procedure, or planning document).
- Communication: Confirm required communication procedures were followed by field and/or laboratory personnel.
- Audits: Review laboratory audit reports, accreditation, and certification records for the laboratory's performance on specific methods; review field forms to verify compliance with work plan and QAPP procedures.

8.2.3 Data Validation Review and Data Qualification

For Level IIA data validation, data quality will be assessed by comparing QC parameters to the appropriate criteria (i.e., limits) as specified in the planning documents (i.e., work plan, SAP, QAPP).

Analytical data may be qualified based on the data validation review. Qualifiers will be consistent with applicable EPA National Functional Guidelines and will be used to provide data users with an estimate of the level of uncertainty associated with the qualified result.

Data validation results will be evaluated with respect to assigned qualifiers to determine any data usability issues. The following qualifiers may be assigned during the data validation process:

J Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

NJ The analyte has been "tentatively identified" or "presumptively identified" as present and the associated numerical value is the estimated concentration in the sample.

R The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.

The objectives, evaluations, and actions employed during the data validation process will be guided by EPA National Functional Guidelines. Laboratories will be permitted to provide CLP-like forms in lieu of original CLP forms. The data validation criteria will not strictly adhere to national functional guidelines, but will also take into consideration method criteria for preservation and holding times; laboratory-specified criteria for surrogate, laboratory control samples, laboratory duplicates, and matrix spikes; and the data validator's professional judgment.

9.0 PROJECTS USING EXISTING DATA

Because the Boeing Developmental Center RI is part of an ongoing program, secondary data may be used to evaluate performance and concentration trends. Historical data will be considered usable for the decisions being made on this project.

10.0 USE OF THIS QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan has been prepared for the exclusive use of The Boeing Company and applicable regulatory agencies for specific application to the Boeing Developmental Center in Tukwila, Washington. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of LAI. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by LAI, shall be at the user's sole risk. LAI warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

11.0 REFERENCES

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