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30 March 2007

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SUBJECT: AFCEE 4P F41624-03-D-8595; Task Order 0384
MMR SPEIM/LTM/O&M Program
CDRL #A006
**Quality Assurance Project Plan for the MMR SPEIM/LTM/O&M
Program – Update**

Dear Mr. Davis:

CH2M HILL is hereby issuing an update of the MMR SPEIM/LTM/O&M Quality Assurance Project Plan (QAPP). Per agreement with EPA and MassDEP at the 10 January 2007 Technical Update meeting, QAPP updates will not be submitted to the regulators for review; rather the QAPP update will be posted directly to the website www.mmr.org. The regulators may review and comment on the QAPP once it is posted on the website. A table summarizing the significant updates to the QAPP is included with this letter. The QAPP is available at <http://www.mmr.org>, General Info, Plans and Protocols (http://mmr.org/irp/plans_FS.htm).

If you have any questions or comments, please contact Nigel Tindall at (508) 968-4670, extension 5620. Ms. Rose Forbes is the Air Force point of contact for this project and may be reached at (508) 968-4670, extension 5613.

Sincerely,

CH2M HILL

A handwritten signature in blue ink, reading "Patricia de Groot", with a long horizontal flourish extending to the right.

Patricia de Groot, P.G., L.S.P.
Program Manager

Enclosures: (1 bound, 1 unbound & 1 CD)

c: AFCEE/MSCD (1 CD)
AFCEE/ICA (1 CD)
HSW/PKVB (1 w/o attach.)
Administrative Record (1 CD)
Paul Marchessault, EPA (1 w/o attach.)
Peter Golonka, GF (1 w/o attach.)
Leonard Pinaud, MassDEP (1 w/o attach.)
Document Control, CH2M HILL (1)

Summary of March 2007 QAPP Updates

QAPP Section	Change
Executive Summary	Updated SPEIM/LTM and O&M areas of concern to include the Chemical Spill -23, LF-2/FTA-2 and operation of Hunter Avenue Treatment Plant.
Section 2.0 – Project Description	
Introduction	Included operation of the SVE system at PFSA in project description.
2.2 – Long Term Monitoring Objectives	Add LF-2/FTA-2 and CS-19
2.4 – Sample Process Design/Scheduling/Reporting	Add text regarding Summary Letter Reports (SLRs)
Section 3.0 – Data Generation and Acquisition	
3.10.2 Overview of Data Flow Process and QC Tools	Added text that describes the use of subM tables on the MMR DW while data is being processed for submittal to AFCEE ERPIMS Database.
3.10.4 – Data Security Procedures	Added text describing current data security procedures.
Table	
Table 2-1 – Data Quality Objectives Summary	Updated table to include LF-2/FTA-2, PFSA, and CS-18.
Appendix A-Project Organization	
A.1 – Project Organization	Updated list of program participants
A.5- QAPP Maintenance and Distribution	Added text regarding new QAPP maintenance and distribution procedures.
A.6 – Project Planning	Added text to include Technical Update meetings as a venue for communicating with the regulators.
Appendix B – Data Validation Tables	
Table B-1 –Review Guidelines for General Organic Parameters	Incorporate text for dioxin/furan sampling and analysis.
Appendix C – Analytical Tables	
C-1 – Requirements for Containers, Preservation Techniques Sample Volumes and Holding Times	Added requirements for the following Analyses: <ul style="list-style-type: none"> • VOCs by TO-15 (air) • EPH by MassDEP Method (soil/water) • VPH by MassDEP Method (soil/water) • Explosives by SW846/8330 (soil/water) • Dioxins/Furans by SW8290 (water) • Algae Identification and Enumeration
C-3A – Reporting Limits for SW846/8260B, VOCs	Added reporting limits for soil/sediment samples.
C-3B-QC Acceptance Criteria for Method SW846/8260B, VOCs	Added QC criteria for soil/sediment.
C-3C-Surrogate Acceptance Criteria for Method SW846/8260B, VOCs	Added surrogate recovery criteria for soil/sediment.
C-3D – Summary of Calibration Acceptance Criteria for Method SW846/8260B, VOCs	Added calibration criteria for soil/sediment.
C-3E – Summary of QC Acceptance Criteria for Method SW846/8260B, VOCs	Added QC checks for soil/sediment.

Summary of March 2007 QAPP Updates

QAPP Section	Change
C-5A – Reporting Limits for Method TO-15	Added reporting limits for TO-15 compounds.
C-5B – Summary of QC Control Acceptance Criteria for Method TO-15	Added QC criteria TO-15.
C-6A – RLS for VPH, MassDEP Method	New table for VPH reporting limits in water and soil.
C-6B – RLS for EPH, MassDEP Method	New table for EPH reporting limits in water and soil.
C-9A – RLS for Method SW846/8330	Added reporting limits for soil/sediment.
C-9B –QC Control Acceptance Criteria for Method SW8330	Added acceptance criteria for soil/sediment samples.
C-9C – Summary of QC Control Acceptance Criteria for Method SW8330	Added QC checks for soil/sediment sampling.
Table C-10A _World Health Organization Toxicity Equivalent Factors for Dioxins	Added Toxicity Equivalent Factors (TEFs) for dioxins.
C-10B- Accuracy and precision acceptance criteria for low-level modified method SW8290	Dioxin/furan analysis in water.
C-10C-Summary of Quality Control Acceptance Criteria for Method SW8290	Dioxin/Furan analysis in water.
C-21A – RLS and Data Evaluation Benchmarks	Added reporting limits and data evaluation benchmarks for: <ul style="list-style-type: none"> ▪ EPH/VPH (MassDEP Method) ▪ Perchlorate (by Methods 314.0 and 331.0) ▪ Dioxin/furans (by Method 8330)
C-21B – RLS and Data Evaluation Benchmarks in Soil	Added table for soil.
Appendix D – Technical Procedures	
TECH-021 Soil Sampling	Added text describing collection and field preservation of soil samples for EPH/VPH analysis.
TECH -031 Groundwater Sampling Using No-Purge Sampling Methods	Updated technical procedure to include passive diffusion bag sampler construction, deployment and sampling, as well as Hydrasleeve sampler deployment and sampling.
TECH-041 Gaseous Sampling with a SUMMA Canister	New technical procedure for the collection of air samples using Summa canisters.

Note: Revisions related to formatting or minor text changes are not included in the above summary.

Massachusetts Military Reservation



Quality Assurance Project Plan for the MMR SPEIM/LTM/O&M Program

March 2007

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ACRONYMS AND ABBREVIATIONS

AFCEE	Air Force Center for Environmental Excellence
ASCII	American Standard Code for Information Interchange
AutoDV	Automatic Data Validation
AV	Ashumet Valley
BRL	below reporting limit
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CD	compact disc
CDA	comma-delimited ASCII
CFR	Code of Federal Regulations
CLTMP	Comprehensive Long Term Monitoring Plan
COC	contaminant of concern
CoC	chain-of-custody
CS	chemical spill
DQI	data quality indicator
DQO	data quality objective
DSR	data summary report
DW	data warehouse
Edata	electronic data
EDB	ethylene dibromide
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERPIMS	Environmental Resources Program Information Management System
FS	fuel spill

ACRONYMS AND ABBREVIATIONS

FSG	Field Services Group
FTA	Fire Training Area
GAC	granular activated carbon
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
HASP	Health and Safety Plan
HPLC	high performance liquid chromatography
ICV	initial calibration verification
ID	identification
IP	In-Plume
IT	Information Technology
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LF	landfill
LM	laboratory manager
Loc ID	Location Identification
LQAP	Laboratory Quality Assurance Plan
LTM	long term monitoring
MA	Massachusetts
MCL	maximum contaminant level
MDL	method detection limit
MMR	Massachusetts Military Reservation
MS	matrix spike
MSD	matrix spike duplicate
O&M	operations and maintenance

ACRONYMS AND ABBREVIATIONS

PARCC	precision, accuracy/bias, representativeness, completeness, comparability
PDF	portable document format
PFSA	petroleum fuel storage area
QA	quality assurance
QAO	quality assurance objective
QAPP	Quality Assurance Project Plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
SD	storm drain
SDG	sample delivery group
SLR	summary letter report
SOP	standard operating procedure
SPEIM	system performance and ecological impact monitoring
SR	Sandwich Road
SRTF	Sandwich Road Treatment Facility
STSP	sample tracking and scheduling program
SVE	soil vapor extraction
TSG	Technical Services Group
VDMS	Validation Data Management System
VIEW	Visual Interface to the ERPIMS Warehouse
VOC	volatile organic compound
YSI	Yellow Springs Instruments, Inc.

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EXECUTIVE SUMMARY

This Quality Assurance Project Plan (QAPP) presents the policies, organization, functions, and specific quality assurance (QA) and quality control (QC) activities associated with collection, analysis, and reporting of data generated in support of the Air Force Center for Environmental Excellence (AFCEE) System Performance and Ecological Impact Monitoring/Long Term Monitoring/Operations and Maintenance (SPEIM/LTM/O&M) Program at the Massachusetts Military Reservation (MMR). This document was originally prepared as a deliverable under the AFCEE Environmental Remediation Construction Contract F41624-01-D-8545, Task Order 71. It has been updated under the AFCEE 4P Contract F41624-03-D-8595, Task Orders 0164, 0251, and 0384.

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This QAPP has been prepared for use by CH2M HILL staff and its subcontractors performing services for the SPEIM/LTM/O&M program at MMR. A primary purpose of the QAPP is to ensure that this program produces analytical data that are scientifically valid and defensible and meet the needs of the SPEIM/LTM/O&M program. To this end, this document includes guidance and procedures to ensure that the data are analyzed and reviewed in a consistent manner.

The SPEIM/LTM/O&M program includes: 1) operation and maintenance of the treatment plants and remedial system components including extraction wells, reinjection wells, and infiltration galleries; 2) the collection and analysis of groundwater, plant process water, surface water, soil/sediment, solids, waste, soil vapor extraction (SVE) system air samples, and landfill gas screening; 3) data validation and preparation of Environmental Resources Program Information Management System (ERPIMS) compliant data deliverables; and 4) interpretation and reporting of system performance data and identification of potential optimizations in the areas of monitoring strategy, data collection, remedial system operation, and/or reporting.

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This QAPP addresses the data collection and analysis activities associated with the plumes, areas of concern, and other monitoring activities listed below that are part of the

current SPEIM/LTM/O&M program. More information can be found in other program documents available at <http://www.mmr.org>.

- Chemical Spill-10 (CS-10), including Sandwich Road (SR), In-Plume (IP), CS-10 Leading Edge Northern Lobe, and Ashumet and Johns Pond Area groundwater LTM areas;
- Fuel Spill-1 (FS-1);
- Fuel Spill-12 (FS-12);
- Fuel Spill-28 (FS-28);
- Storm Drain-5 (SD-5);
- Landfill-1 (LF-1) including Bourne Upgradient monitoring;
- Chemical Spill-23 (CS-23)
- Ashumet Valley (AV);
- Southwest Plumes, including Chemical Spill-4 (CS-4), Chemical Spill-20 (CS-20), Chemical Spill-21 (CS-21), and Fuel Spill-29 (FS-29);
- Landfill-2/Fire Training Area-2 (LF-2/FTA-2);
- Chemical Spill-18 (CS-18);
- Chemical Spill-19 (CS-19);
- Petroleum Fuel Storage Area (PFSA);
- Recreational Beach Monitoring, and
- Residential Well Monitoring.

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Monitoring program details are presented in the *Comprehensive Long Term Monitoring Program (CLTMP)* (AFCEE 2006c), which is available at www.mmr.org under General Information/Plans & Protocols (http://mmr.org/irp/plans_fs.htm). Facts sheets for each plume are available at www.mmr.org under General Information/Fact Sheets (<http://mmr.org/irp/genprog/factshts.htm>).

The current O&M program encompasses the following groundwater remediation systems:

- Sandwich Road Treatment Facility (SRTF) including extraction fences/wells and reinjection wells for CS-10 SR and Leading Edge Northern Lobe;

- FS-12 treatment plant;
- FS-28 treatment plant;
- FS-1 treatment plant;
- LF-1 treatment plant;
- AV treatment plant;
- CS-10 In-Plume treatment plant;
- Hunter Avenue treatment plant (CS-4, CS-20, CS-21, FS-29, CS-23, and LF-1 [EW-6]); and
- PFSA SVE system.

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The SPEIM/LTM/O&M program includes collection of data for plume monitoring and treatment system monitoring. For the SPEIM program, plume monitoring includes both hydraulic and chemical monitoring to assess the influence of the remedial systems on plume characteristics. These data are also used in groundwater modeling to optimize and predict future performance of the remedial systems and migration of the plumes. For sites in the LTM program, monitoring data is used to evaluate changes in the nature and concentration of contaminants to assess natural attenuation. For O&M, the data is used to assess the effectiveness of the treatment plants in removing the plume contaminants of concern (COCs) from the groundwater, to calculate the mass of the COCs removed, and to guide operational decisions including optimization initiatives.

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QAPP conformance is required for all technical and field staff participating in the SPEIM/LTM/O&M program, including subcontracted laboratory teams. All CH2M HILL subcontractors will be required to comply with procedures documented in this QAPP to ensure comparability and representativeness of data quality. The QAPP provides guidance and procedures for collection and analysis of the data as well as instructions on how to evaluate the quality of the data and processes for corrective actions.

The QAPP will be revised as necessary when guidelines and regulatory documents are revised or when additional sampling or analytical methods are required to meet project requirements. The QAPP is to be used in conjunction with associated program documents including: 1) the *CLTMP* (AFCEE 2006c) which provides details on plume-

specific and plant-specific monitoring programs including sampling locations, analytical methods, and frequencies; 2) the *Final Operations and Maintenance Plan* (AFCEE 2006a) for operation of the treatment plants and system components; 3) the *SPEIM/LTM/O&M Health and Safety Plan (HASP)* (AFCEE 2006b); and 4) Project Notes.

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents the policies, organization, functions, and specific quality assurance (QA) and quality control (QC) activities associated with collection, analysis, and reporting of data generated in support of the Air Force Center for Environmental Excellence (AFCEE) System Performance and Ecological Impact Monitoring/Long Term Monitoring/Operation & Maintenance (SPEIM/LTM/O&M) Program at the Massachusetts Military Reservation (MMR). A written and approved QAPP is required for every monitoring and measurement project mandated or supported by the U.S. Environmental Protection Agency (EPA) through regulations, contracts or other formalized means not currently covered by regulation. Guidelines followed in preparing this plan are set out in EPA *Guidance for Quality Assurance Project Plans* (EPA 2002), Region I EPA-New England *Compendium of Quality Assurance Project Plan Requirements and Guidance* (EPA 1999), and the AFCEE QAPP (AFCEE 2005).

1.1 PURPOSE

This QAPP has been prepared for use by CH2M HILL staff and its subcontractors performing services for the SPEIM/LTM/O&M program at MMR. A primary purpose of the QAPP is to ensure that this program produces analytical data that are scientifically valid and defensible and meet the needs of the SPEIM/LTM/O&M program. To this end, this document includes guidance and procedures to ensure that the data are analyzed and reviewed in a consistent manner.

The QAPP is to be used in conjunction with associated program documents including: 1) the *Comprehensive Long Term Monitoring Plan (CLTMP)* (AFCEE 2006c) which provides details on plume-specific and plant-specific monitoring programs including sampling locations, analytical methods, and frequencies; 2) the *Final Operations and Maintenance Plan* (AFCEE 2006a) for operation of the treatment plants and system components; 3) the *SPEIM/LTM/O&M Health and Safety Plan (HASP)* (AFCEE 2006b); and 4) Project Notes. In addition, further details regarding the SPEIM/LTM/O&M program can be found in various documents available at <http://www.mmr.org>.

Specifically, the CLTMP is available at http://mmr.org/irp/plans_fs.htm and fact sheets for each plume are available at <http://mmr.org/irp/genprog/factshts.htm>. Plume locations are shown in [Figure 1-1](#).

QAPP conformance is required for all technical and field staff participating in the SPEIM/LTM/O&M program, including subcontracted laboratory teams. All CH2M HILL subcontractors will be required to comply with procedures documented in this QAPP to ensure comparability and representativeness of data. The QAPP provides guidance and procedures for collection and analysis of the data as well as instructions on how to evaluate the quality of the data and processes for corrective actions.

1.2 QAPP REVISIONS AND SUPPLEMENTS

Revisions to the QAPP may be necessary when guidelines and regulatory documents are revised or when changes to QAPP procedures, processes, or other specifications are required to meet project needs. For example, analytes, sample media, and/or analytical methods not currently included in this QAPP may be added to the SPEIM/LTM/O&M program in the future. In general, if the change is likely to be required on an ongoing basis, the QAPP will be revised to reflect the change. However, in cases where the deviation from the QAPP procedures, processes, or other specifications is made on a one-time or limited basis, this variance may be documented in a Project Note or Data Summary Report (DSR).

1.3 QAPP ORGANIZATION

The QAPP consists of five sections and four appendices. A description of the work to be performed and the data quality objectives (DQOs) for the project are presented in Section 2.0. Data collection methods, sample handling, the data management program, and the QC requirements for the analytical data generated are described in Section 3.0. Data review, data validation, and data usability processes are described in Section 4.0. References are included in Section 5.0. The project management and team organizational structure is presented in [Appendix A](#). [Appendix B](#) contains the data validation tables. [Appendix C](#) contains the analytical tables and quality control acceptance criteria. Technical procedures are included in [Appendix D](#).

2.0 PROJECT DESCRIPTION

The SPEIM/LTM/O&M program includes: (1) operation and maintenance of the treatment plants and remedial system components including extraction wells, reinjection wells, and infiltration galleries; (2) the collection and analysis of groundwater, plant process water, surface water, soil/sediment, solids, waste, soil vapor extraction (SVE) system air samples, and landfill gas screening; (3) data validation and preparation of Environmental Resources Program Information Management System (ERPIMS) compliant data deliverables; and (4) interpretation and reporting of treatment system performance data and identification of potential optimizations in the areas of monitoring strategy, data collection, remedial system operation, and/or reporting. This section summarizes the various types of monitoring, the DQOs, scheduling and reporting, and the measurement performance criteria.

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2.1 SPEIM AND O&M OBJECTIVES AND APPROACH

The SPEIM and O&M programs were developed to monitor plume changes and to ensure the effective operation of the AFCEE groundwater remediation systems at MMR. The remedial systems are designed to meet the plume-specific remedial objectives. The principal objectives of the SPEIM and O&M programs are to:

- determine if the remedial systems are meeting their design objectives;
- monitor the changes in the mass, volume, spatial dimension, and general chemistry of the contaminant plumes;
- identify improvements to the monitoring program; and
- identify potential optimization activities to improve the performance of the remedial systems.

These objectives are met through monitoring of selected media (i.e., groundwater, surface water) within and outside the plume boundaries, treatment plant monitoring, and groundwater flow and transport modeling.

The SPEIM and O&M programs use the data collected through plume and treatment plant monitoring to evaluate the effectiveness of the remedial systems and to identify the potential impacts on the surrounding ecosystems as a result of system operations.

2.1.1 Plume Monitoring

Plume monitoring includes both hydraulic and chemical monitoring to assess the influence of the remedial systems on plume characteristics and utilizes groundwater modeling to optimize and predict future performance of these systems.

Hydraulic monitoring is conducted to: (1) assess the hydraulic nature of the aquifer; and (2) verify the design criteria for hydraulic control of the plume are being met. Groundwater elevations are measured in specific wells and, in conjunction with groundwater flow modeling, the results are used to assess the horizontal and vertical extent of system effects on groundwater levels within the aquifer.

Chemical monitoring involves the collection of analytical data from selected media to: (1) evaluate the nature and extent of the plume and contaminant migration; (2) assess system performance; (3) provide input to and verify results of groundwater modeling; and, (4) provide a basis for system optimization.

Groundwater modeling is used in the SPEIM program as an analytical tool to: (1) simulate the movement of the plumes over time; (2) predict the performance of the remedial system wellfield designs; (3) evaluate and optimize system performance; and (4) predict the effects of external stresses (i.e., other nearby remedial systems, water supply wells, or changes in regional water levels) on the groundwater system. The modeling approach includes the development of contaminant plume shells and a numerical groundwater flow model coupled with a particle tracking model or a solute transport model. Steady-state flow models are used in the SPEIM program to simulate groundwater levels resulting from system operation (e.g., drawdown or mounding near areas of extraction and reinjection and in ecologically sensitive areas). The resulting model-generated flow fields are combined with particle tracking to delineate hydraulic capture zones of the extraction wells. The simulated flow fields are also used with solute-transport models to predict groundwater concentrations, mass removal rates, and plume cleanup as a function of time.

An evaluation of the appropriateness of the SPEIM well network is also performed to determine essential locations for plume characterization and system evaluation. This evaluation and optimization of the monitoring well network is an ongoing effort throughout the SPEIM program.

2.1.2 Treatment System Monitoring

Treatment system monitoring includes the collection of flow rate information from extraction wells, infiltration trenches, and treatment plants. In addition, water samples are collected from three general locations within the treatment plants: (1) the influent water; (2) between the granular activated carbon (GAC) units; and (3) the effluent water. Monitoring results are used to assess the effectiveness of the treatment plants in removing the plume contaminants of concern (COCs) from the groundwater, to calculate the mass of COCs removed, and to guide operational decisions.

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2.2 LONG TERM MONITORING OBJECTIVES

Areas that are monitored without remedial actions include LF-2/FTA-2, CS-19, Ashumet and Johns ponds, and Storm Drain-5 (SD-5). In these areas of concern, chemical monitoring is used to evaluate changes in the nature and concentration of contaminants and to assess natural attenuation.

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2.3 DATA QUALITY OBJECTIVES

The DQOs for many of the monitoring activities described above have been defined by previous and ongoing investigations. [Table 2-1](#) summarizes the nature of the MMR SPEIM/LTM DQOs (e.g., monitoring contaminant nature and extent, remedial system performance, source areas, etc.). These DQOs are used to develop the data collection programs and criteria of the measurement data for this project. In addition, [Table 2-1](#) summarizes the data evaluation benchmarks for the SPEIM/LTM program (i.e., drinking water standards, plant discharge limits, and human health screening values) for each plume. DQOs are specifically (e.g., numerically) shown in [Appendix C, Tables C-21A](#) and [C-21B](#).

For O&M, the DQOs are:

- Determine contaminant concentrations in influent, effluent from the lead carbon adsorber (intermediate), and plant effluent; and
- Measure treatment system performance and calculate mass removal;

2.4 SAMPLE PROCESS DESIGN/SCHEDULE/REPORTING

SPEIM/LTM/O&M monitoring programs are dynamic in nature. Sample locations, sample frequencies, and sample analytes may change as groundwater plume geometry changes; plume constituents attenuate through remediation, and/or attenuation; and/or the plume conceptual model becomes more refined. Modifications to the SPEIM/LTM/O&M program are documented in project notes or technical memoranda that are reviewed and approved by the regulators.

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The sampling design for this program is the result of the DQO process and regulator input. Summaries of the SPEIM/LTM/O&M monitoring programs for each plume are contained in the CLTMP, which is updated as changes to the program are approved.

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The reporting of data generally consists of periodic data presentations at technical update meetings (following major sampling events) and summary letter reports (SLRs) that are submitted on an annual basis. The SPEIM SLRs present information on the results and analysis of the chemical and hydraulic monitoring of the plumes and at the treatment plants. A summary of the remedial system performance is also provided in the SLRs.

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Data used in the presentations and SLRs are obtained from the MMR Data Warehouse (DW). The MMR DW contains chemical results obtained from analytical laboratories including analyte concentrations reported below DQO-based reporting limits (RLs) (i.e., estimated concentrations). However, summary tables created for data presentations and the SLRs contain only those analytical results equivalent to or greater than the RLs; estimated concentrations less than the RL will be reported as below reporting limits (BRL).

2.5 MEASUREMENT PERFORMANCE CRITERIA (PARCC)

Once the DQOs have been identified, measurement performance criteria that will be necessary to achieve these overall quality objectives must be defined. Measurement performance criteria are defined by the following parameters: precision, accuracy/bias, representativeness, completeness, comparability (often referred to as PARCC), and sensitivity and RLs. These parameters are used as qualitative and quantitative indicators of requirements for measurement data and are referred to as data quality indicators (DQIs). DQIs are the detailed QC specifications for the PARCC parameters.

The DQIs presented in this QAPP are considered to be the routinely achievable quality measures for field and analytical procedures. They represent the minimum acceptable specifications for field and analytical measurements and should be used in conjunction with RLs to select appropriate analytical and field methods for the expected data uses. The DQIs are then used as comparison criteria during data quality review to determine whether the minimum requirements have been met and the data may be used without qualification. Thus, the data produced by multiple suppliers and laboratories over extended periods of time are ensured of being comparable within the DQIs. When selecting analytical methods, required RLs and appropriate QC levels should be considered.

Precision

Precision is the degree of agreement among repeated measurements of the same characteristics, usually under a given set of conditions. Precision data indicate how consistent and reproducible the field sampling and/or analytical procedures have been. Overall project precision is measured by collecting data from replicate field samples. Precision, specific to the laboratory, is measured by analyzing laboratory replicate samples, which include matrix spike duplicate (MSD) samples or unspiked duplicate samples.

If two replicate samples are collected in the field and both analyzed, these samples are referred to as field duplicates. If more than two replicate samples are collected and analyzed, these samples are referred to as field replicates. Duplicate precision is evaluated

by calculating a relative percent difference (RPD), while replicate precision is evaluated by calculating the relative standard deviation. These measurements reflect matrix precision, field collection techniques, and sample homogeneity. If laboratory control samples (LCSs) and LCS duplicates (LCSDs) are analyzed, the precision statistic measures method precision only and does not represent field influences.

Accuracy

Accuracy refers to the extent of agreement between an observed value (result) and the accepted or true value. Accuracy is frequently used synonymously with bias. Specifically, bias describes the systematic or persistent error associated with a measurement process.

Accuracy is assessed through the collection and analysis of blanks (field and laboratory) and other QC samples. QC samples may include performance evaluation samples and/or spikes, including surrogate spikes, LCS, and matrix spike (MS)/MSD samples. Surrogate spikes and MS/MSDs measure matrix accuracy, while LCSs measure method accuracy. Blank data are used to assess the accuracy of sample results by evaluating whether contamination was introduced during the collection or processing of the sample resulting in false positive data. Analyte accuracy/bias is evaluated by calculating percent recovery of the spiked compound(s).

Representativeness

Representativeness is a qualitative term that expresses the degree to which data collected for a sample accurately and precisely reflects the environmental conditions of the population. It takes into consideration the magnitude of the site area represented by one sample and assesses the reasonableness of the design rationale. Representativeness also reflects the ability to collect samples and analyze those samples in such a manner that the data generated accurately represents the conditions at the site. The use of standard operating procedures (SOPs) for sample collection and established methods for analysis helps ensure that samples are representative of site conditions. All work done for this project will follow SOPs that ensure representative sample collection. Laboratories will

follow analytical methods listed in this QAPP that are appropriate for the analytes of interest and matrices tested.

Completeness

Completeness is a measure of the amount of valid, usable data obtained compared to the amount of data that is expected under normal conditions. Completeness can be measured in the field and in the laboratory. It is expressed as a percentage of the number of valid measurements that should have been collected. The goals for field and laboratory completeness are 95 percent for aqueous samples and 90 percent for solid samples. Completeness is usually measured by analyte. For compounds of concern, the completeness goals are a critical factor in measuring the success of the project.

Comparability

Comparability expresses the confidence with which one data set can be compared to another. Comparability will be achieved through the consistent use of established procedures for field operations, sampling, and analytical technique. SPEIM and O&M data collected and analyzed under this QAPP will use similar, if not identical, field and laboratory methods, data review and validation criteria, and other procedures. Where procedures are modified, a thorough evaluation will be made on the potential impacts on comparability of data.

Split samples may be used as a method of comparability. The comparability of split samples is expressed as RPD. In general, if the detected sample results are greater than or equal to two times the RL for organics or are greater than or equal to four times the RL for inorganics, the RPD for aqueous split samples must be less than or equal to 30 percent. For inorganic parameters, the RPD must be less than 35 percent for soil. For organic parameters the RPD must be less than 50 percent for soil. When one or both sample results are less than two times the RL, the acceptable comparability performance is a difference of less than plus/minus two times the RL for water and air samples and plus/minus four times the RL for solid samples.

Sensitivity and Reporting Limits

Sensitivity is the ability of the method or instrument to detect the COC and other target compounds at the level of interest. The RLs for each matrix, analytical parameter, concentration level, and analyte are presented below in the Analytical Method Performance Criteria section of this plan. These were developed to meet the DQOs for each plume, area of concern, and O&M treatment plant. RLs in this QAPP are, in general, consistent with those that have been used in previous SPEIM and O&M sampling events.

Laboratory-specific method detection limits (MDLs) are lower than the RLs and might be used by the project team in decision processes. The MDL is defined as the minimum concentration of a substance that can be measured and reported with a 99 percent confidence that the analyte concentration is greater than zero. For all parameters, subcontractor laboratories must perform annual MDL studies as defined in 40 Code of Federal Regulations (CFR) 136 Appendix B and MDL verification (AFCEE 2005). Laboratory-specific MDLs shall be established for each method, matrix, analyte, and instrument and must be validated every 12 months. MDLs must be less than ½ of the QAPP RLs. In the event that the MDL is not less than ½ of the QAPP RL, the laboratory must contact the CH2M HILL Project Chemist.

In addition to annual MDL studies, CH2M HILL requires that when any significant changes to instrumentation occur (i.e., a new column), a new MDL study must be performed. Immediately following the MDL study, one MDL verification check will be performed on each target compound calculated MDL. The MDL check standard shall be spiked at approximately two times the calculated MDL. The MDL is considered verified if the check standard produces a response at least three times above the instrument's noise level and greater than the method blank associated with the MDL verification study. If the verification response is too low, spike at successively higher concentrations until verification criteria are met. The concentration that meets the criteria is the verified MDL.

The MDL study verification checks will be sent to the CH2M HILL Project Chemist for review and approval prior to performing sample analysis.

Where multiple instruments are used, the MDL used for reporting purposes shall represent the least sensitive instrument (AFCEE 2005). Upon completion of each instrument MDL study and MDL verification check, the least sensitive MDL by compound will be used for reporting purposes for all respective instruments used for the method analysis. This multiple instrument MDL approach does not apply to analyses via EPA methods 524.2 and 504.1 which require Massachusetts certification. For these analyses, an instrument-specific MDL will be reported.

The data package case narrative will indicate the following, where applicable:

- each compound for which the calculated MDL is raised due to the MDL verification study; and
- that multiple instruments were used and the MDL reported represents the least sensitive instrument.

Analytical Method Performance Criteria

This section describes the precision, accuracy, completeness, and detection limit requirements for the SPEIM/LTM/O&M program. These criteria, along with the representativeness and comparability goals in the above section, were established to meet the project DQOs while recognizing the limitations of available test methods.

Analytical method performance criteria are summarized in tables attached as [Appendix C](#). [Table 2-2](#) provides a list of the analytical method tables included in [Appendix C](#). Included for each analytical method are the target analyte lists with the associated RLs and the statistical method performance criteria. Specifically, the tables in [Appendix C](#) summarize the QC acceptance criteria for each analytical method and include the frequency of the QC analyses, as well as the corrective action when these criteria are not achieved. The referenced analytical method-specific criteria must be achieved and documented as well. Lastly, [Tables C-21A](#) and [C-21B](#) in [Appendix C](#) provide a comparison of the RLs for each target analyte for each method to the various benchmarks used in the SPEIM/LTM/O&M Program. [Table C-21A](#) includes groundwater benchmarks and [Table C-21B](#) includes soil benchmarks.

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[Table C-1](#) in [Appendix C](#) summarizes the requirements for sample containers, preservation, sample volumes, and holding times. The sample volumes listed in [Table C-1](#) are the minimum sample volumes required to perform the respective analyses; actual sample bottles used are dependent on laboratory supplies and availability. [Appendix C](#) Tables C-2A through C-18C present target compound lists for each analytical method and specific QC criteria for relevant methods. For most methods, the first table presents the RLs for each target analyte in the respective method. The second and/or third tables present the acceptance criteria for accuracy of spiked analyte(s) and surrogate recoveries. These tables also present the acceptance criteria for precision of MSs, LCSs, and laboratory duplicate analyses. The last table summarizes the QC acceptance criteria that the laboratory must follow for each analytical method, and includes frequency, acceptance criteria, and corrective actions.

The criteria presented in these tables are to be considered compliance criteria for the laboratory when performing these analyses. The referenced method-specific criteria should be followed and documented. CH2M HILL must be notified regarding any variances to the criteria. The AFCEE QAPP (AFCEE 2005) is intended to provide guidance, when necessary. Task-specific criteria and/or methodology, not included in this section, may be added or appended as required by specific task requirements.

2.6 CORRECTIVE ACTIONS

Corrective action and documentation may be required as a result of deviations from field or analytical procedures. Deficiencies identified during audits and data quality evaluations may also call for corrective action. Examples of conditions that may require corrective actions and documentation requirements are presented in this section.

2.6.1 Corrective Actions for Field Data Collection

Corrective action may be required as a result of deviations from field procedures. Examples of conditions for which corrective actions may be initiated are as follows:

- When procedures or data compiled are determined to be incorrect;
- When equipment or instrumentation is found to be incorrectly operated or maintained;
- When field procedures are not or cannot be followed resulting in potential impact to data quality;
- When the custody of samples and analytical results cannot be traced with certainty;
- When QAPP requirements have not been achieved;
- When designated approvals have not been obtained;
- As a result of system and performance audits; and
- As a result of management assessment.

Field deviations shall be reported to the Field Services Group (FSG) manager immediately, as well as being recorded in the field logbook. If the deviation has the potential to impact data quality, the Plume Lead and Technical Services Group (TSG) Manager will be notified within 24 hours of discovery. It will be determined whether there are any impacts to analytical data quality and appropriate corrective action will be taken. Additional project team members will be notified as necessary.

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2.6.2 Corrective Actions for Laboratory Services

Corrective action documentation may be required as a result of deviations from analytical procedures in a laboratory. Examples of conditions for which corrective actions may be necessary are as follows:

- Quality control data are outside the warning or acceptable windows for precision and accuracy;
- Target analytes detected in blanks at concentrations above the RL for any target compound;
- The laboratory QA Director detects deficiencies during internal audits; and
- As a result of unsatisfactory laboratory performance evaluation sample results.

Corrective actions shall be implemented immediately when the bench analyst identifies a non-conformance in QC sample results. If the problem could potentially impact the data quality, the matter must be referred to the laboratory supervisor and the laboratory QA/QC

officer for further investigation. The Laboratory Manager shall contact the CH2M HILL Project Chemist within 24 hours of any QAPP nonconformance that could impact data quality.

Corrective actions may include:

- Reanalyzing suspect samples;
- Recalibration with new standards;
- Eliminating blank contamination;
- Resampling and analyzing samples;
- Evaluating and amending sampling and analytical procedures;
- Accepting data with an acknowledged level of uncertainty;
- Recalibrating analytical instruments; and
- Qualifying or rejecting the data.

All laboratory QC problems that will affect the final data must be discussed with the CH2M HILL Project Chemist as part of the corrective action process. These discussions must occur within the sample extraction/analysis holding time to obviate any effect on the DQOs. Once resolved, full documentation of the corrective action must be filed with the laboratory supervisor and the laboratory QA/QC officer and provided to CH2M HILL in the laboratory data package deliverable.

At minimum, corrective action documentation shall include:

- The type of deviation or deficiency;
- The date of occurrence;
- The impact of the deviation or deficiency, such as samples affected; and
- The corrective action taken.

3.0 DATA GENERATION AND ACQUISITION

3.1 SPEIM/LTM/O&M SAMPLE NOMENCLATURE

All field samples and field-collected volumes for in-situ (field) or laboratory analyses will be identified according to the SPEIM/LTM/O&M sample naming nomenclature. This nomenclature is described below along with restrictions and example sample names. The standard MMR location identification nomenclature will follow technical procedure TECH-045 ([Appendix D](#)).

Before beginning fieldwork, the Field Services Lead will review the proposed sampling scope and coordinate the creation of a list of unique sample identifiers with the Project Data Manager. This listing of sample identifiers will be maintained by the Sampling Lead, which will be responsible for enforcing the use of the standardized numbering system during all field activities.

Each analytical laboratory sample and/or field parameter data set collected during a project will be assigned a unique sample identifier. The objective of the sample identifier is to uniquely identify each discrete volume or set of data collected from the sample location. A different sample identifier must be applied to each sample that has a different:

- Location Identification (Loc ID);
- Sample matrix;
- Date and time collected; and
- QC purpose.

A standardized numbering system will be used to identify all samples collected during sampling activities. The numbering system will support procedures developed to ensure accurate tracking of all samples collected.

For non-routine sampling events the Plume Lead should meet with representatives of Field Services, Data Management and the Project Chemist to discuss features of the proposed sampling event to establish unique field sample identifications.

3.2 LABORATORY ELECTRONIC DATA DELIVERABLE (EDD) DEFINITION

3.2.1 Format

The Electronic Data Deliverable (EDD) file from the laboratory will be a comma-delimited American Standard Code for Information Interchange (ASCII) (CDA) file in the format listed below. There will be one file per hard copy report and the filename of the EDD file will be in the format REPORTID.txt or REPORTID.csv, where REPORTID is the hard copy report identifier for the sample delivery group.

The first row of the EDD will contain the names of each of the 47 data fields listed in the **Field Name** column of the EDD Specification Table (refer to [Table 3-1](#)). The names will be enclosed in double quotes (“”) and each quoted field name will be separated from the next one by a comma. In other words, the first five values in the first row will be:

“VersionCode”, “LabName”, “SDG”, “FieldID”, “NativeID”

and the last four values in the first row will be:

“LeachTime”, “LeachLot”, “AnalysisLot”, “CalRefID”

3.2.2 Content

The EDD Specification Table ([Table 3-1](#)) lists the attributes of the columns for each row of the CDA file. The fields should be reported in the order indicated in the **Field Number** column.

The **Data Type** column describes the value in the field as either text (alphanumeric), number (numeric only), date (format: mm/dd/yyyy), or time (24-hour format hh:mm). If the field is conditional or optional and there is no value to be reported, a null (i.e., no) value is reported. For a text field, a zero-length string (i.e., "") is not reported.

The **Data Length** column contains the maximum length of a text value for the particular data field.

The **Rqmt** column contains a code indicating the requirement of a value in this field. The codes are:

R – required for all rows

O – optional for all rows

C – conditional and depends on the type of result reported

Each row of information reported in the EDD file must be uniquely identified by the values in the following five fields:

FieldID

AnalysisMethod

ExtractionMethod

LeachMethod

ParamID

If an analytical sample must be diluted or reanalyzed and the result is reported in addition to the original analytical sample, the diluted or reanalyzed sample should have a FieldID value that is different from that of the original sample. This can be accomplished through the addition of a suffix to the original FieldID that establishes a new and unique FieldID for the associated records. The laboratory will identify these samples in the LR Type (Field Number 7) of the EDD specifications table ([Table 3-1](#)).

All laboratory electronic data submitted to CH2M HILL is required to include a Chemical Abstract Service (CAS) Registry Number reference (Field Number 21 of the EDD specifications table) ([Table 3-1](#)) in addition to common name and ERPIMS

PARAMID. The CAS Registry Number is the identifier used through the data validation process to ensure accurate analyte identification. This process satisfies the EPA CAS Registry Number Data Standard 2180.1.

3.2.3 EDD Valid Values

The laboratory will be provided with a list of valid values that will be used in constructing the EDD. Examples of some valid values are presented in [Table 3-2](#).

3.3 SAMPLING METHODS

The overall quality of sample results is dependent on proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. To ensure samples are collected and managed properly and consistently, SOPs addressing sampling activities have been developed. These SOPs were developed in accordance with federal, state, local, and AFCEE requirements. The purpose of an SOP is to increase reproducibility and to document each of the steps required to perform the task. Correctly implemented SOPs should produce data of acceptable quality, which meet project DQOs. Current SOPs (also known as “Technical Procedures”) are summarized in [Table 3-3](#) and are included as [Appendix D](#). Any deviations from sample procedures will be noted in the sampling logbook.

3.4 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

3.4.1 Field Documentation

Field documentation is maintained in the following types of documents: field logbooks, sample labels, chain-of-custody (CoC) forms, and field data sheets for recording sampling activities, geological operations, and field calibration and maintenance data. The following general guidelines will be used for maintaining field documentation:

- Documentation will be completed in permanent black ink;
- All entries will be legible; and
- Errors will be corrected by crossing out with a single line, dating, and initialing.

Field logbooks will be maintained consistent with TECH-035 ([Appendix D](#)).

3.4.2 Field Documentation Management System

Field logbooks will be issued and maintained by the FSG Manager or designee. The FSG Manager or designee will be responsible for the daily check-in/check-out of logbooks and will ensure that routine (weekly at a minimum) QC checks are performed as logbooks and logbook copies are turned in at the end of each day. The FSG Manager or designee will also ensure that a document control number is issued for each logbook. At the conclusion of each day, the logbook will be returned to the logbook storage cabinet. At the conclusion of a task or when a logbook has been completed, the logbook will be submitted to the Document Control Coordinator for records retention.

3.4.3 Sample Labels

Partially preprinted labels will be generated using the Sample Tracking and Scheduling Program (STSP) (described in Section 3.10) and will be attached to all sample containers at the time of sample collection. The label will be completed in indelible ink (date, time, initials), covered with clear tape, and will contain the following information, as appropriate:

- CoC number;
- Date and time of sample collection;
- Analyses requested;
- Field sample identification number;
- Preservative used; and
- Sampler's initials.

3.4.4 Chain-of-Custody (CoC) Record

Sample custody procedures are designed to ensure that sample integrity is maintained from collection to final disposition. A critical aspect of sound sample collection and analysis protocols is the maintenance of strict CoC procedures as described in TECH-026 ([Appendix D](#)). CoC procedures include tracking and documentation during sample collection, shipment, and laboratory processing.

CoC forms will be used to document the integrity of all samples. To maintain a record of sample collection, transfer of samples between personnel, shipment of samples, and receipt of samples at the laboratory, a CoC form will be filled out for each sample set at each sampling location.

3.4.5 Shipping Containers

Samples will be packed and shipped as described in Tech-028 ([Appendix D](#)). Samples will be packaged in thermally insulated, rigid coolers, according to Department of Transportation specifications 173 Subparts A and B, and 172 Subparts B, C, and D.

3.4.6 Laboratory Custody Procedures

Laboratory custody procedures associated with sample receipt, storage, preparation, analysis, and general security will be assessed through laboratory audits and review of respective laboratory SOPs.

The laboratory will, at a minimum, check all incoming samples for integrity and note any observations on the original CoC form or a separate sample log-in form. In addition, the following general procedures will be used by the laboratory sample custodian in maintaining the CoC form once the samples have arrived at the laboratory.

- The samples will be cross-checked to verify that the information on the sample labels matches the CoC record;
- If all information is correct, and there has been no tampering with the custody seals, the “received by laboratory” box on the CoC record will be signed and dated;

- The samples will be distributed to the appropriate laboratory section for analysis; an internal CoC form will be used to track the sample throughout the laboratory until the sample is consumed or disposed.

For samples that are received at the laboratory on the same day of collection, the cooler temperature will be recorded on the CoC form. For samples that are not received at the laboratory on the same day of sample collection, the temperature of the temperature blanks will be recorded on the CoC form. The Project Chemist must be notified if the temperature of the temperature blank upon sample receipt is not within the sample preservation requirements in [Table C-1, Appendix C](#). All laboratories will indicate whether or not samples were received on ice on the CoC form.

If samples must be transferred from the laboratory to another laboratory for analysis, then the samples must be transferred on ice. Documentation of custody transfer must be noted on the CoC form, and the sample receipt temperature at the receiving laboratory must be noted on the CoC form.

Each sample will be logged into the laboratory information system by assigning a unique laboratory sample number. Samples will be stored and analyzed according to the specified methods. The original CoC form and the log-in form will be maintained with the original data package.

If any containers received by the laboratory are broken, samples are improperly preserved, holding times have expired, or there are any discrepancies among the CoC records, sample labels or sample analyses, the laboratory's sample custodian will notify the Project Chemist within 24 hours.

3.4.7 Corrections to Documentation

All original data recorded in field notebooks, sample identification tags, CoC records, and receipts-for-sample forms will be written with waterproof ink, unless prohibited by weather conditions. None of these serialized documents are to be destroyed or thrown

away, even if they are illegible or contain inaccuracies that require a replacement document.

In general, if an error is made on a document, corrections may be made by simply drawing a single line through the error and entering the correct information. The erroneous information should not be obliterated. Any error discovered on an accountable document should be corrected by the person who made the entry. All corrections must be initialed and dated. Corrections to logbooks are specifically addressed in Tech-035 ([Appendix D](#)) and corrections to CoCs are specifically addressed in Tech-026 ([Appendix D](#))

3.5 ANALYTICAL METHOD REQUIREMENTS

On- and off-site laboratory analytical methods are summarized in [Table 2-2](#) and in [Appendix C](#). Contracted laboratories are required to conduct analysis consistent with their Laboratory Quality Assurance Plan (LQAP) and SOPs.

3.6 QUALITY CONTROL REQUIREMENTS

QC samples may include but are not necessarily limited to equipment blanks, ambient blanks, field duplicates, cooler temperature blanks, MS/MSDs, trip blanks, and field split samples.

General QC sample collection frequencies are defined in [Table 3-4](#). These frequencies may be reduced based on project or task-specific historical data and DQOs. Precision and accuracy criteria are assessed during data validation; the accuracy criteria are summarized in Section 2.5.

For SPEIM/LTM sampling, [Table 3-4](#) presents "routine" and "non-routine" QC sample frequencies. To be considered "routine", the sample must be a groundwater or surface water sample that is being analyzed for volatile organic compounds (VOCs) by Methods SW8240 or E524.2, or EDB analysis by Method E504.1. In addition, the sample must have enough historical data to justify the "routine" level of QC. To make this

determination, the Project Chemist (or designee) will query the data warehouse (DW) for each sample location and analysis combination. If the location and analysis combination is found at least three times in the DW and the data does not indicate accuracy or precision problems (as indicated by "J" flagging above the RL or "UJ" flagging for nondetects for more than approximately 2/3 of the data), the location will be considered a "routine" sampling location for the purposes of assigning QC samples. Samples that are identified as being in support of risk assessment and all other SPEIM/LTM samples that do not meet the definition of "routine" samples are considered "non-routine" for purposes of assigning QC samples.

Corrective actions to QC sampling results include immediate notification to the Project Chemist, who will consult with the Plume Lead, Sampling Lead and/or O&M Manager, and field personnel, as necessary, for possible re-sampling.

3.6.1 Field QC

3.6.1.1 Equipment Blanks

Equipment blanks are collected to evaluate decontamination procedures, and to demonstrate that disposable equipment (e.g., polyethylene sleeves) do not introduce contaminants. Equipment blanks will be obtained by passing deionized water from the Field Services Millipore system through or over the sampling devices.

All analytes in equipment blanks should be less than the RL. If these concentrations are exceeded, an assessment of the disposable sampling equipment or decontamination procedures will be performed.

3.6.1.2 Trip Blanks

Trip blanks are prepared by pouring deionized water from the Field Services Millipore system into a VOC sample container. Trip blanks are sealed, transported to the field, stay sealed while VOC samples are collected, and transported back to the laboratory in the same cooler as the VOC samples.

3.6.1.3 Ambient Blanks

Ambient blanks are used to assess the potential introduction of contaminants from ambient sources to the samples during sample collection. They will be collected as needed to evaluate whether contaminants have been introduced into the samples during the sampling procedures, and will be obtained by pouring deionized water from the Field Services Millipore system into the sampling container at the sampling point or location specified by the Field Sampling Lead.

3.6.1.4 Field Duplicates

Field duplicate samples are collected to determine the precision of the method. They are collected from the same source under identical conditions. The collection method for the duplicate samples is dependent on the media sampled and the target analytes. A duplicate sample is treated independently of its parent sample and will be sent blind to the laboratory.

Sample locations for collection of field duplicate samples can be identified when the sequence of sampling locations are determined, so that field duplicate collection will take place evenly over the plumes as much as possible. Specific locations will be designated as field duplicate samples by the Project Chemist before sample collection. There may be circumstances when an insufficient volume of sample is available for a field duplicate. The Project Chemist may then substitute another sample location for collection of field duplicate samples, as long as the same method will be performed.

The following factors will be considered when selecting the sampling location from which a field duplicate sample will be collected (listed in decreasing order of preference):

- Sampling location with known contamination;
- Sampling location with suspected contamination;
- Sampling location downgradient from historical release/contamination; and
- Random sampling location.

3.6.1.5 Temperature Blanks

A temperature blank is a sample bottle containing deionized water obtained from the Field Services Millipore system, which is shipped in a cooler with the field samples. Upon receipt by the laboratory, the temperature of the water is measured to ensure that the temperature preservation criteria are met.

A temperature blank must be included in each cooler going to an off-site laboratory for any analysis that has a temperature preservation requirement. Samples going to the on-site laboratory are typically collected just hours prior to delivery to the laboratory. Therefore, a temperature blank is not a meaningful quality indicator since the samples would still be cooling toward the sample preservation requirement when delivered to the on-site laboratory. However, samples will be placed on ice upon collection regardless of whether the samples are being sent to the on-site or off-site laboratory.

3.6.2 On-Site and Off-Site Laboratory QC

Internal laboratory QC checks are used to provide indications of the state of control that prevailed in the laboratory at the time of sample analysis. QC checks that involve field samples, such as matrix and surrogate spikes and duplicates, provide an indication of the presence of matrix effects. QC samples include method blanks, LCSs, surrogate spikes, and MSs and MSDs. Calibration and QC requirements by method are presented in [Appendix C](#).

The LCS, MS, and MSD will be spiked with the same solution containing the target compounds of interest. All of the SPEIM QAPP QC limits must be used as opposed to a laboratory's in-house limits. Any QAPP QC limit failure must be noted in the case narrative. Samples and their associated QC must be analyzed on the same instrument.

3.6.2.1 Method Blanks

Laboratory pure water (also called laboratory reagent blank) serves as a method blank to monitor each analytical batch for interference and for contamination from glassware, reagents, and other potential contaminants generated within the laboratory. The method blank is processed through the entire sample preparation and analytical procedures along with each sample batch. One method blank per analytical sample batch per matrix will be analyzed. If a target analyte is found at a concentration that exceeds the acceptance limit, corrective action is triggered to identify and eliminate contamination sources.

When a target compound consistently appears as method blank contamination, CH2M HILL requires the laboratory to investigate and determine the cause of the method blank contamination. The method blank contamination must be eliminated in a timeframe acceptable to the CH2M HILL Project Chemist. CH2M HILL must immediately be notified of any samples that may have been impacted by possible laboratory contamination.

3.6.2.2 Laboratory Control Samples (LCSs)

LCSs are used as a reference to assess the accuracy of an analysis. The LCS for this project will consist of reagent water or cleaned sand spiked with known amounts of analytes that come from a source different than that used for calibration standards. A subset of target analytes are spiked into the LCS. If LCS results exceed the specified control limits, corrective procedures must be implemented. At least one LCS will be analyzed with each sample analytical batch.

3.6.2.3 Surrogates

Surrogates are analytes that behave similarly as the analytes of interest, but which are not expected to occur naturally in the samples. Surrogates are spiked into calibration standards, field samples, and QC samples prior to sample preparation. Recoveries of surrogates can be used as an indicator of the accuracy of the measurement of target analytes.

3.6.2.4 Matrix Spikes/Matrix Spike Duplicates

A MS is a solution of method analytes or a subset of method analytes for multi-analyte methods at known concentrations that is spiked into a field sample before sample preparation and analysis. The MS is subjected to the same preparation and analytical procedures as the field sample. Spiked samples are used in order to indicate the appropriateness of the method for the matrix by measuring recovery. Another aliquot of the sample is spiked as above for the MSD analysis.

The Project Chemist will designate the sample location where the MS/MSD pair will be collected. This will ensure that the frequency requirements are met and that an even distribution of MS/MSDs are collected across the plumes. The Project Chemist will assign MS/MSDs in a similar manner as field duplicates. The following preferences will be considered when assigning MS/MSDs:

- Sampling location with known contamination within the calibration range;
- Sampling location downgradient from historical release/contamination; and
- Random sampling location.

The percent recovery of each spiked compound is used to assess bias caused by matrix interferences, and the RPD between the duplicate spikes is used to assess the precision of the method for the specific sample matrix. For methods not amenable to matrix spiking, such as some inorganic methods, laboratory duplicates will be analyzed.

The limits for precision and accuracy of the MS/MSD are the same as those for the LCS/LCSD. The corrective action is to verify that the associated LCS complies with specifications, and if so, to report the data with a flag to indicate matrix interference. The MS/MSD results for each matrix will be compiled after all samples from that location have been reported to identify location-specific matrix interferences. Additional qualification of samples that were not used for MS/MSDs may be required based on this assessment.

3.6.2.5 Calibration Standards

Calibration standards are a series of known standard solutions used by the analyst for calibration of the instruments (i.e., preparation of the analytical curve). Initial calibration is performed for each analytical method as required, usually using a range of calibration standards containing all analytes. These standards are used to determine the calibration range of the instrument. The reported concentration of an analyte in a sample, sample extract, or diluted sample must not exceed the calibration range determined by the highest concentration of the initial calibration standards. Acceptance criteria must be met before the instrument is used to analyze field samples.

Initial and continuing calibration verification standards (ICV and CCV) containing all analytes are analyzed daily to verify that the initial calibration curve or response factors demonstrate acceptable performance of the analytical instrument. The results of the ICVs or CCVs must meet acceptance criteria before sample analysis may proceed. See [Appendix C](#) for method-specific details.

3.6.2.6 Other Method-Specific QC

Other quality controls specific to each method and the corrective action to be taken when QC criteria are not met is specified in [Appendix C](#). The formulas below will be used to calculate the QC parameters specified in this section.

QC Parameter Calculations

Parameter	Symbol	Formula	Definition
Relative Percent Difference	RPD	$\left[\frac{(X_1 - X_2)}{\left(\frac{(X_1 + X_2)}{2} \right)} \right] \times 100$	Measure of variability that adjusts for the magnitude of observations
Percent Recovery	R	$\left(\frac{X_{meas}}{X_{true}} \right) \times 100$	Recovery of spiked compound in pure matrix

QC Parameter Calculations

Parameter	Symbol	Formula	Definition
Percent Recovery (Matrix Spike)	R	$\frac{\text{spiked sample} - \text{unspiked sample}}{\text{value of added spike}} \times 100$	Recovery of spiked compound in sample matrix

X = Observation (concentration)

3.6.2.7 Additional Analytical Requirements

All computerized data reduction used in quantitating target analytes must be reviewed by the analyst to determine the accuracy of the quantitation performed. In the event that the automated software does not integrate a peak (corresponding to a target analyte) correctly, the laboratory is required to manually integrate the peak. Manual integrations must be performed consistently.

The subcontract laboratory is required to provide all analysts performing methods that rely on interpretation of chromatographic data with training on appropriate software or manual integration practices. The laboratory also will make every effort to minimize the use of manual integration of data. If the need arises to use manual integration to correct a software auto-integration error, the manual integration will be clearly identified in the data. Before and after enlargements of the manual integration will be provided on an appropriate scale that allows an independent reviewer to evaluate the need and quality of the manual integration. The analyst will also document the reason for the manual integration on the chromatogram along with their date and initials. The laboratory manager, or designee, will approve the manual integration by dating and initialing the after manual integration chromatogram.

In addition, CH2M HILL requires that the laboratory investigate any excessive retention time shifts. Further, CH2M HILL requires that field samples be stored in a separate refrigerator from standards.

Organic compound peaks that appear relatively large compared to surrogate and internal standards, and appear close to target compound retention times, must have documentation in some form within the hardcopy data package as verified non-target compounds. In addition, CH2M HILL requires that if a target compound is not reported because it is less than the MDL, then there must be documentation within the hardcopy data package (preferably on the raw chromatogram) indicating that the peak found is less than the MDL.

3.7 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

The primary objective of an instrument/equipment maintenance program is to promote the timely and effective completion of a measurement effort. The maintenance program is designed to minimize the downtime of crucial sampling and/or analytical equipment due to expected or unexpected component failure. In implementing this program, efforts are focused in three primary areas:

- Establishment of maintenance responsibilities;
- Establishment of maintenance schedules for major and/or critical instrumentation and apparatus; and
- Establishment of an adequate inventory of critical spare parts and equipment.

These are discussed in the following subsections.

3.7.1 Maintenance Responsibilities

Equipment and instruments used in this project fall into two general categories:

- Laboratory instruments; and
- Field sampling equipment (e.g., field meters, etc.).

Maintenance of laboratory instruments is the responsibility of the laboratory contracted to perform the analytical portion of this program. Generally, the Laboratory Manager or Supervisor of a laboratory is responsible for the instruments and equipment in the work

area. The Laboratory Manager will establish maintenance procedures and schedules for each major equipment item. Although this responsibility may be delegated to laboratory personnel, the manager retains responsibility for ensuring adherence to prescribed protocol. All laboratories are bound by contractual agreements to maintain the ability to produce data that meet the project objectives and to follow method specifications.

Maintenance responsibilities for field equipment are assigned to the Equipment/Property Manager and Field Team Leaders for specific sampling tasks. However, the field team using the equipment is responsible for checking the status of the equipment prior to use and reporting any problems encountered. The field team is also responsible for ensuring that critical spare parts are included as part of the field equipment checklist. Non-operational field equipment is removed from service and a replacement obtained (if necessary).

All field instruments will be properly protected against inclement weather conditions during the field activity. At the end of each working day, all field equipment shall be taken out of the field and placed in a cool, dry room for overnight storage.

3.7.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each piece of equipment. Other maintenance activities are conducted on an as-needed basis. Manufacturers' recommendations provide the primary basis for established maintenance schedules, and manufacturers' service contracts provide primary maintenance for many major instruments.

Each field analytical instrument is assigned an instrument logbook. All maintenance activities are recorded in the instrument log, which is maintained in property management. The information to be entered includes:

- Date of service;
- Person performing service;
- Type of service performed and reason for service;
- Replacement parts installed (if appropriate);
- Date of next scheduled service; and
- Miscellaneous information.

On a routine basis, Yellow Springs Instruments, Inc. (YSI) instrument electrodes will be inspected for scratches, cracks, salt crystal buildup, and membrane/junction deposits. Probes will be cleaned with nonphosphate detergent and reagent-grade water or with a weak solution of hydrochloric acid. After acid soaking, electrodes will be thoroughly rinsed with deionized water. Instruments that are sensitive to soap and solvents, like the combination pH meter, will be rinsed with potable water and deionized water generated from the Millipore system. The probes will be cleaned daily and stored overnight according to the manufacturer's recommended procedures.

3.7.3 Spare Parts

In addition to a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. The inventory includes those parts and supplies that:

- Are subject to frequent failure;
- Have limited useful lifetimes; and
- Cannot be obtained in a timely manner should failure occur.

The Equipment/Property Manager and the respective laboratory managers are responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, an in-house source of backup equipment and instrumentation should be available.

3.8 INSTRUMENT CALIBRATION

3.8.1 Field Calibration

For water analyses, field instruments needing calibration are the YSI Sonde 6820 and 6920 which contain probes that measure pH, conductivity, dissolved oxygen, turbidity, temperature, and oxidation-reduction potential. YSIs will be calibrated consistent with Tech-011. At minimum, these meters will be calibrated before the start of work, and at the end of the sampling day. Any instrument “drift” from prior calibration will be recorded in a calibration notebook.

Calibrated equipment will be uniquely identified by using either the manufacturer’s serial number or other means. Calibration records traceable to the equipment will be readily available for reference. In addition, the results of calibrations and records of repairs will be recorded in a logbook.

Equipment that fails calibration or becomes inoperable during use will be removed from service and either segregated to prevent inadvertent use or tagged to indicate it is out of calibration. Such equipment will be repaired and satisfactorily recalibrated. Equipment that cannot be repaired will be replaced.

Equipment that has failed re-calibration will be reported to the FSG Manager. The FSG Manager will evaluate the potential impact and inform the Plume Lead, TSG Manager, and Project Manager as needed.

3.8.2 Laboratory Calibration

Laboratory instruments will be appropriately calibrated by qualified personnel prior to sample analysis. Only certified standards of known purity may be used. Calibration will be verified at specified intervals throughout the analysis sequence. The frequency and acceptance criteria for calibration are specified for each analytical method in [Appendix C](#).

When multi-point calibration is specified, the concentrations of the calibration standards should bracket those expected in the samples. Samples may be diluted, if necessary, to bring analyte responses within the calibration range. The laboratory will inform the CH2M HILL Project Chemist of any results that will be reported above the calibration range, prior to reporting. In addition, the laboratory may report results between the MDL and RL as estimated values. The RLs must be at or above the lowest calibration standard.

Organic methodologies generally give options for initial calibration procedures and provide acceptance criteria to evaluate each option. However, a hierarchy for use of these options as well as a summary of good laboratory techniques to practice when performing an initial calibration are not generally stated in a concise manner. This section establishes some criteria for the various calibration procedures.

Calibration Techniques:

- Check instrument operating conditions and provide routine maintenance. Keep a log of all maintenance activities for future preventative maintenance and troubleshooting.
- Ensure that the instrument is free of contamination prior to calibration. Do not perform any blank subtraction.
- Always analyze the entire initial calibration curve prior to analyzing samples.
- Always analyze the calibration curve from lowest standard to the highest standard.
- The lowest standard in the calibration curve must be at or below the required RL.
- The other standard concentrations must define the working range of the instrument or the expected range of concentrations found in the samples.
- The calibration standards must be analyzed over a continuous and consecutive timeframe. If one calibration standard fails to meet criteria it may be reanalyzed at the end of the calibration sequence. The failure of multiple standards suggests an instrument problem or operator error.
- Either external or internal calibration can be employed for gas chromatography (GC) and high performance liquid chromatography (HPLC) methods. Internal calibration must be used for gas chromatography/mass spectrometry (GC/MS) methods.
- A minimum of 5 calibration points must be used for the calibration curve for GC and HPLC and a minimum of 5 calibration standards must be used for GC/MS depending on the applicable method.
- Midpoint standards cannot be removed from the calibration curve. If the lowest standard is removed, the RL for that compound increases. If the highest standard is

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removed, the linear range is shortened for that compound. If points are removed from the curve, there must still be a minimum of 5 points remaining as described above.

- A linear regression requires five standards, a quadratic model requires six standards and a third order polynomial requires seven standards.
- Most compounds tend to be linear and a linear approach using response factors produces consistent acceptable results. It is not acceptable to use an alternate calibration procedure other than linear regression when a compound fails to perform in its usual manner. When this occurs it is indicative of instrument issues or operator error.
- A non-linear model should only be used with known compounds that do not have a linear model over the working range typically used for a particular method.

3.9 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

It is the laboratory's responsibility to provide sample containers, certified clean to EPA specifications. Sample containers may not be re-used.

All non-dedicated laboratory and sampling equipment must be decontaminated and visually inspected prior to each use.

Reagents and consumables that contact samples must not contain the analytes of interest at levels equal to or greater than the detection limits. All standards must be certified and be of known purity. Certificates of analysis must be maintained on file by the laboratory.

3.10 DATA MANAGEMENT

3.10.1 General

During SPEIM/LTM/O&M monitoring activities at MMR, CH2M HILL will collect a variety of environmental data that will support evaluation of plume migration, remedial system performance, and environmental impact. To ensure the quality of the data collected, and to deliver the data to the end-user in an efficient manner, a data management system has been established. This data management system and associated tools are briefly described in the following subsections. Data assessment processes are presented in Section 4.0 of this document.

3.10.2 Overview of Data Flow Process and QC Tools

The elements of the data flow process can generally be divided into three main phases: 1) data collection planning and field work; 2) laboratory analysis and data validation, and; 3) data entry into the MMR DW. A number of tools for quality control checking are utilized throughout the data flow process to provide high quality data to the end-users as soon as possible.

During the initial phase of the data flow process (planning and fieldwork phase), the STSP will be used by CH2M HILL staff to initiate the sample collection and sample documentation and tracking processes. During the second phase (laboratory analysis and data validation) the CH-Analyzer and Validation Data Management System (VDMS) software will be used to aid in evaluation of the quality of the data. At the third phase of the data flow process (data entry into the data warehouse), an ERPIMS Tool is used to format the data. The AFCEE MMR Visual Interface to the ERPIMS Warehouse (VIEW) is the application that is used by end-users to access and query data in the MMR DW. Additional details on use of each of the tools utilized by CH2M HILL (STSP, CH-Analyzer, VDMS, and ERPIMS Tool) are summarized below.

- **Sample Tracking and Scheduling Program (STSP).** The STSP is used to develop work schedules and daily assignments for field crews, identify sampling container and preservation requirements, identify appropriate analytical laboratories for samples, and print labels for sample bottles and CoC forms. The STSP also tracks QC lot information by plume and well pump identification (ID) numbers associated with equipment blanks, and all field measurement data.
- **CH-Analyzer.** Before the laboratory analytical data are processed through VDMS, the laboratory EDD must be processed through CH2M HILL's CH-Analyzer (Microsoft Access database application). The CH-Analyzer application includes several automated diagnostic checks to verify format and content compliance with EDD specifications. The analytical laboratory must use CH-Analyzer to check the format and content compliance of its EDD files, and correct any errors prior to transmitting the EDD to CH2M HILL. The laboratory must forward the checked EDD and hard copy of the data to CH2M HILL's Redding, California office for EDD verification and loading.
- **VDMS.** Once the EDD verification is complete, the EDD must be electronically transferred into CH2M HILL's VDMS for data quality verification and validation according to project specifications. At import, the data are checked against a list of valid well names. If the laboratory data applies to a Loc ID that is not a valid well name, the CH2M HILL field coordinator and/or data manager must be contacted for

resolution, and necessary corrections made to the STSP and VDMS. Once this step is completed, validation can begin.

VDMS can be operated to perform semi-automated and automated validation of environmental analytical data. When operated in an automated fashion, VDMS identifies and/or flags data for compliance variances:

- Dilutions;
- Re-extractions;
- Confirmation Samples;
- Lab Blanks;
- Field Blanks;
- Blank Spikes;
- Blank Spike Duplicates;
- Field Duplicates;
- Holding Times;
- Matrix Spikes;
- Matrix Spike Duplicates; and
- Surrogates.

At the first level of automation, VDMS performs QC checks against acceptable valid values, runs a completeness check on the electronic data, and links the electronic data (Edata) to the data from the STSP export. When utilizing full automation (AutoDV), VDMS automatically imports the Edata, validates, then creates an exceedance report that is sent to a Project Chemist for review.

When operated in the semi-automated fashion, VDMS provides the data validator with prompts to aid in evaluating the data such as “A method blank has benzene detected in it, did you remember to flag it?” VDMS also provides automated calculations, linking of field QC samples with field samples, and linking of surrogates with the AFCEE-defined analytes, and runs comparisons to QAPP QC limits that are incorporated into the application.

VDMS presents the findings for the chemist’s acceptance and/or changes to data validation flags and final approval. VDMS presents reports that summarize all of the analytical data, determine whether analytical results meet accuracy and precision criteria as specified by the project QAPP, and isolate data that indicate contaminant concentrations that exceed project action levels.

The chemist can also use VDMS to track sample delivery groups (SDGs). VDMS can also be used to perform a statistical comparison to historical data and determine if there are outliers in the current data set which might require additional scrutiny by the

Project Chemist. Additional effort may include retrieval of the raw analytical data to verify that the laboratory correctly reported the data.

Electronic [Adobe Acrobat portable document format (PDF)] validation reports will go through senior chemist review weekly. Upon the senior chemist's approval of the validation efforts, an automated notification to the ERPIMS specialist will be generated to indicate that the data are ready for ERPIMS.

AFCEE ERPIMS Tool (ERPTool). Once the data verification and validation is complete, the data are converted to ERPIMS format and loaded into the ERPTool, an AFCEE ERPIMS QA/QC tool. The ERPTool is used to check for data integrity, consistency, and adherence to the ERPIMS Data Loading Handbook and Valid Value lists. New data processed weekly through the ERPTool are loaded into the submission (SubM) tables of the MMR DW. The data are temporarily stored in the SubM tables of the MMR DW until they are processed and loaded by AFCEE Brooks into the Production tables of the AFCEE ERPIMS database at Brooks. Once loaded into the database at Brooks, the data are then returned to CH2M HILL for loading into the Production tables of the MMR DW. Once the data are loaded into Production at MMR, it is removed from the SubM tables.

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3.10.3 Data Archiving Procedures

Record storage will be performed in two stages:

- Storage during the project; and
- Permanent storage of records directly related to the project.

Information generated from field activities will be documented on appropriate forms and will be maintained on-site. These include CoC records, field books, well construction forms, boring logs, location sketches, and site photographs. In addition, notes from critical project meetings and telephone conversations will be filed in the on-site document control system.

The EDDs will be managed and stored at CH2M HILL's Redding, California office. The hardcopy data packages will be filed by the SDG or laboratory batch as appropriate in CH2M HILL's Denver, Colorado office. Upon project closeout, the data packages will be archived in Denver with the project files. CH2M HILL will use storage facilities that provide a suitable environment that minimizes deterioration or damage and prevents loss. Edata will be maintained on both CH2M HILL's corporate local area network and MMR's network servers.

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The electronic loaded and processed data will be managed in the MMR DW. Filenames for the EDDs will include the SDG or lab batch designation and the date received in order to facilitate document control and retrieval.

3.10.4 Data Security Procedures

MMR analytical data is stored in the MMR DW for access by contractors, agencies, regulators, and AFCEE. For web-based systems, users access the MMR DW through an encrypted Secured Socket Layer connection to the DW server. Additionally, the web system uses Public Key Infrastructure authentication which requires all users to provide a valid user-specific certificate, either from an AFCEE-provided Common Access Card or through an approved External Certification Authority digital certificate. All MMR DW accounts are password protected using Oracle authentication. User access is maintained by the database administrator following AFCEE security requirements.

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All files received from subcontractors are scanned for common viruses using standard current virus protection programs.

3.10.5 Data Backup and Recovery

All project files reside on network servers at MMR. Data files stored on the MMR DW server are backed up every day in an Oracle export. In addition, a weekly tape backup is made of the data files on the MMR DW server. These tape backups are kept in a secure location separate from the MMW DW.

Data files contained within an EDD are emailed to the CH2M HILL Redding (California) office where they are imported into the VDMS system. Every night a backup of all the files on the Redding server, including the VDMS files, is made. Monthly, a copy of the nightly backups are sent off site to a secure location. In addition, archive compact discs (CDs) are made of the backups in Redding.

4.0 DATA QUALITY ASSESSMENT

Quality objectives are essential to ensuring that data collected are sufficient to meet the intended goals. Quality objectives are pre-established goals or benchmarks used to monitor and assess the progress of the project and the quality of the work performed. It is essential that quality objectives be defined prior to starting project work to ensure that activities performed in support of the project yield data that is sufficient to meet the project objectives.

Data are potentially subject to sampling and data reduction errors. Quality assurance objectives (QAOs) are established to control the sources of errors and quantify the errors whenever possible. QC procedures are designed to both increase sample data quality and help interpret discrepancies in the results. QAOs are quantifiable and qualifiable parameters that are expressed in terms of the PARCC parameters. The QAOs established in this QAPP will be used for both work plan development and data quality review. A description of the PARCC evaluation is provided in Section 2.5.

Data quality assessment will be performed by CH2M HILL according to the steps described below. Measurement data must be consistently evaluated, assessed, and documented to determine whether program QAOs have been met, to quantitatively assess data quality, to identify potential limitations on data use, and to assess whether site-specific DQOs have been met.

4.1 PRELIMINARY DATA REVIEW

Field and laboratory documentation will be reviewed to identify problems or anomalies in the implementation of the sample collection and analytical procedures. Preliminary data review will include data validation; electronic evaluation of the data for anomalies, patterns and/or trends in the data set; and comparison of the data set to historical means.

4.2 DATA VALIDATION AND USABILITY

All data will undergo two levels of review and validation: (1) at the laboratory; and (2) outside the laboratory by a CH2M HILL chemist.

Laboratory Review

The analyst performing the tests shall review 100 percent of the data. Data qualifiers shall be added or applied electronically when acceptance criteria were not met and corrective action was not successful, or corrective action was not performed. After the analyst's review has been completed, 100 percent of the data shall be reviewed independently by a senior analyst or by the section supervisor. Analytical batch comments shall be added in the form of a case narrative to explain any nonconformance or other issues.

The primary responsibility for the implementation of these procedures within the laboratory resides with the laboratory manager (LM) or equivalent. The LM will approve laboratory reports before transferring the information to CH2M HILL.

Data Evaluation

All project data will be validated by CH2M HILL as part of the data assessment for this project. This review will be performed on an analytical batch basis by assessing QC samples and associated field sample results. Data validation guidelines for the SPEIM/LTM/O&M projects have been developed in accordance with EPA-New England Region I Guidelines, National Functional Data Validation Guidelines, and general AFCEE requirements.

EPA Region I specifies a tiered approach to data validation to suit varying project quality objectives. In summary the three data validation tiers, as defined by EPA Region I, are as follows:

Tier I: The data are verified for completeness and are reviewed for format and content to ensure that all requested samples were analyzed, and that all laboratory data are present.

Tier II: A Tier I data validation is performed, and the results of QC checks and procedures are evaluated. The data summary reporting forms provided by the laboratory are reviewed. Qualifiers are applied by the reviewer, as applicable.

Tier III: Tier I and Tier II data validations are performed. The raw data is examined in detail to check for calculation, compound identification, and/or transcription errors.

Both screening and definitive data will be collected. Screening data will be reviewed using the Tier I level data validation and will be flagged with an "S" qualifier in the MMR DW. For the SPEIM/LTM/O&M project, screening data provide a semi-quantitative and accurate qualitative assessment of chemical conditions. Screening data are defined as data where one of the following applies: 1) DQOs will support the use of data/methodologies which are less precise/semi-qualitative, or 2) data validation of definitive data indicates that the data do not meet this QAPP criteria but still have value to the project. In all cases, screening data should be considered as estimated.

Definitive data will be reviewed using VDMS in the semi- or fully-automated manner as discussed in Section 3.10.2 or will be otherwise reviewed according to Tier II level validation.

The data validation criteria are summarized and included in [Appendix B](#).

As the program continues to progress and both the laboratories and the processes for collecting and analyzing samples becomes more routine, the validation process that will be used for SPEIM/LTM and O&M will become more automated and rely more on the electronic data from the laboratories and the historical data in the MMR DW.

In the fully automated approach, the electronic data will be used to do the comparisons against the limits for elements of QC that are available in the laboratory electronic

deliverables. The elements of QC and their limits and logic for applying flags are incorporated in the AutoDV tool (AutoDV). This automated process includes data flagging for issues related to method blanks, equipment blanks, trip blanks, ambient blanks, LCSs, MS samples, surrogate recoveries, and reconciliation of dilutions and re-extractions. Data flags, as well as the reason for each flag, are entered into a database and that is available to the data validator/chemist. A final flag is applied to the data by the AutoDV application after evaluating all flags automatically applied. The final flag is the most conservative of the automated validation flags.

Historical data are used to provide additional confidence to the automated validation process. They are reviewed for outlying quantitative data that might suggest a data quality issue that the automated validation procedure would not have observed, but that might critically affect the usability of the data. Where new data appears to be inconsistent with historical data, the automated validation process will be superceded by manually performing data validation using one or more of the elements of the Tier I, Tier II, or Tier III validation requirements to resolve the inconsistency identified.

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Data package case narratives are reviewed for analytical issues. Data packages will be reviewed for exception reports and corrective action reports. The data quality assessment reduction process will be reviewed to determine how it is working and how it could be improved.

Data Validation Summary Guidelines are included as Tables B-1 through B-3 in [Appendix B](#). Written details are provided in the following sections for the minimum QC elements to be reviewed as previously specified.

Data Summary Reports

Findings from the data evaluation process are routinely presented in the form of DSRs. Two types of DSRs may be used for the program: a DSR for definitive data and/or a DSR for screening level data. At a minimum, a DSR for definitive data will include discussions of the following QC elements (where and when applicable):

- Hold-time and sample preservation;
- Instrument calibration (not included in AutoDV);
- Method blanks;
- Surrogates;
- Internal standards (not included in AutoDV);
- Field blanks;
- Field duplicates;
- Laboratory duplicates;
- Laboratory control samples;
- Matrix spikes;
- Chain-of-custody (not included in AutoDV); and
- Completeness.

Additionally, a table of qualified data will be provided for the data user.

A DSR for screening level data will include a discussion of the Tier I level data validation. Analytical data completeness, format, and content results will be summarized. An “S” flag will be applied to all screening level analytical data. The “S” flag indicates that all screening level analytical data are estimated.

Data Evaluation Report Review

After the Project Chemist or designee has completed the DSR, a senior CH2M HILL chemist will review the DSR for technical accuracy and completeness prior to release to the plume lead for inclusion in reports.

Quality Assurance Audits

Program monitoring to verify compliance with the requirements established in this QAPP will consist of a comprehensive system of periodic audit and surveillance activities. These activities will include coverage of a reasonable cross section of active work to

ensure that the project documents and applicable procedural requirements are properly implemented.

Field audits of selected sites may be performed during site activities to verify that project quality requirements are met. Field audits will provide a review of all pertinent field activities, such as:

- Equipment decontamination;
- Specific field procedure methods;
- Field documentation;
- Field measurements;
- Sample collection/documentation (CoC); and
- Sample packing/shipping.

External audits of contractor operations by contractor, client, or regulatory agencies may be performed at the discretion of the external organization. Contractor personnel will assist in all external audits of field and office activities.

The analytical laboratory will conduct both internal and external QC checks. External QC checks include participation in EPA and other certification and performance evaluation programs. The results of quarterly performance evaluation samples will be made available to the Project Chemist upon request. Internal QC checks (duplicates, blanks, and spiked samples) will be performed in accordance with the approved methods.

Laboratory systems will be audited annually by CH2M HILL. Laboratory system audits may consist of an on-site audit, status reports, and/or detailed data package review. If any problems are noted during the laboratory system audit, specific corrective actions will be implemented on a case-by-case basis.

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