

REVISED - Technical Memorandum

Phase 3 Chemical Data Gap Investigation and Radionuclide Sampling Results Drainage Sediment Sampling in Area III Santa Susana Field Laboratory Ventura County, California

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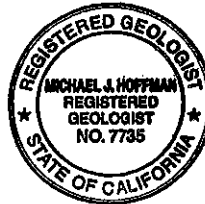
August 2013

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Radionuclide Sampling Results
Drainage Sediment Sampling In Area III
Santa Susana Field Laboratory
Ventura County, California**


Contract DE-EM0001128
CDM Smith Task Order DE-DT0003515

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.



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Acronyms and Abbreviations

%D	percent difference/percent drift
%R	percent recovery
mg/L	milligram per liter
ng/kg	nanogram per kilogram
ng/L	nanogram per liter
pg/L	picogram per liter
µg/L	microgram per liter
AOC	Administrative Order on Consent
bgs	below ground surface
CAS	chemical abstract service
CDM Smith	CDM Federal Programs Corporation
CoC	chain of custody
DOE	Department of Energy
DQI	data quality indicator
DQO	data quality objective
DTSC	Department of Toxic Substances Control
DUAR	data usability assessment review
EDL	estimated detection limit
EFH	extractable fuel hydrocarbon
EMAX	EMAX Laboratories, Inc.
FSDS	field sample data sheet
FSP	field sampling plan
FTL	field team leader
GIS	geographic information system
GPS	global positioning system
HSA	Historical Site Assessment
HxCDF	hexachlorodibenzofuran
ICP	inductively coupled plasma
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LLI	Lancaster Laboratories, Inc.
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NDMA	n-Nitrosodimethylamine
PAH	polycyclic aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, comparability, completeness and sensitivity
PCB	polychlorinated biphenyl
PCT	polychlorinated triphenyl
PID	photoionization detector
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control

RCRA	Resource Conservation and Recovery Act
RL	reporting limit
RPD	relative percent difference
SDG	sample delivery group
SIM	selective ion monitoring
SOP	standard operating procedure
SOW	statement of work
SSFL	Santa Susana Field Laboratory
SVOC	semi-volatile organic compound
TM	technical memorandum
TPH	total petroleum hydrocarbon
USEPA	U.S. Environmental Protection Agency
WP/FSAP	Work Plan/Field Sampling and Analysis Plan

Section 1

Introduction

This Technical Memorandum (TM) presents the results of chemical and radiological analyses of drainage sediment samples collected within Area III of the Santa Susana Field Laboratory (SSFL) in Ventura County, California. Sediment sampling within Area III was conducted jointly with the U.S. Environmental Protection Agency (USEPA). Sediment sampling with USEPA differed from the Phase I sampling in that CDM Federal Programs Corporation (CDM Smith) was responsible for collection of the physical sample with a portion of the sample being provided to USEPA for radiological analysis. CDM Smith was responsible for the chemical analyses.

Collection of sediment samples for chemical analyses was performed under two planning documents:

- *Master Field Sampling Plan for Chemical Data Gap Investigation Sampling at Area IV, Santa Susana Field Laboratory, Ventura County, California* (CDM Smith 2012a) (Master FSP)
- *Addendum No. 3 to Master Field Sampling Plan for Chemical Data Gap Investigation, Phase 3 Soil Chemical Sampling at Area IV, Santa Susana Field Laboratory, Ventura County, California, Drainage Sediment Sampling in Area III* (CDM Smith 2012b) (Addendum to the Master FSP)

The Master FSP is Appendix A of *Work Plan for Chemical Data Gap Investigation, Phase 3 Soil Chemical Sampling at Area IV, Santa Susana Field Laboratory, Ventura County, California* (CDM Smith 2012c), which also includes Appendix B, Quality Assurance Project Plan (QAPP), Appendix C, Worker Safety and Health Program, and Appendix D, Standard Operating Procedures (SOPs).

USEPA managed the soil samples for radiological analyses based on the procedures described in *Field Sample Plan Addendum, Surface Water and Sediment Sampling, Silvernale, R2A, and R2B Retention Ponds and Drainages, Santa Susana Field Laboratory Site* (HydroGeologic, Inc. 2011)

This TM also provides a description of the sampling activities and a discussion of the analytical data review findings for Phase 3 sampling for drainage sediment samples within Area III. The TM does not provide an interpretation of the results. The data provided in this TM are intended to be combined with data collected under the prior Resource Conservation and Recovery Act (RCRA) Facility Investigation and the Phase 1 chemical collocated sampling program to support the Soil Remedial Action Implementation Plan for chemicals in soil in Area IV. The soil and sediment sampling is being performed to address the chemical investigation activities under the Administrative Order on Consent for Remedial Action [Docket Number HSA-CO 10/11-037] between the U.S. Department of Energy [DOE] and the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC).

1.1 Objective and Basis for Data Gap Investigation Sampling for Drainage Sediment Sampling Within Area III

The Administrative Order on Consent (AOC) signed by DOE and DTSC requires DOE to evaluate the extent of contamination that is either contiguous to or emanating from Area IV. The southern portion of Area IV drains to the east and southeast into Area III. The drainage sediment sampling effort was performed to address the migration of contaminants in drainages (the drainage pathway). Therefore,

drainages crossing into Area III and leading to the Silvernale Pond (the major receiving water body for the drainages) were targeted for sampling.

CDM Smith was responsible for all aspects of the field sampling program under Phase 3 of the AOC, including:

- Locating the sample locations selected as a result of the data gap investigation in the field using geographic information system (GIS) coordinates
- Collection of all samples in accordance with the procedures and controls specified in the Master FSP and FSP Addendum, including but not limited to: sample collection, sample container preparation, sample handling, and documentation
- Following applicable SOPs for each activity performed during the field sampling program
- Providing USEPA with sample material for radionuclide analysis
- Sample management and shipment, laboratory coordination, and chemical analyses of the samples
- Data review and validation of the chemical data

USEPA's data validation report is included as Appendix E and radionuclide data as Appendix B and Appendix G of this Report.

1.2 Geology

Drainage sediment sampling in Area III is within the Chatsworth Formation, which is composed predominantly of sandstone interbedded with siltstone and shale. The overlying native soils encountered in Area III range from predominantly silty sands to sandy silts at the surface. Additional information regarding the Area IV geology can be found in Volume I of *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California* (CH2M Hill 2008).

1.3 Technical Memorandum Organization

This TM includes the following sections:

- **Section 1 - Introduction** – Summarizes the basis and objectives of the Phase 3 drainage sediment sampling within Area III
- **Section 2 - Field Sampling and Analytical Methods** – Provides details regarding field sampling procedures and laboratory analytical methods
- **Section 3 - Soil Sample Analytical Results - Chemical** – Provides a summary of detected analytical results for each chemical; the appendices provide the overall results
- **Section 4 - Soil sample Analytical Results – Radionuclides** – Provides a summary of detected analytical results for each radionuclide; the appendices provide the overall results
- **Section 5 - Data Usability Assessment** – Discusses the results of the data review and validation processes for the chemical data. USEPA's data validation report is provided in Appendix E of this Report.
- **Section 6 - References**

Section 2

Field Sampling and Analytical Methods

Surface sediment samples were collected from 17 locations in Area III between July 17 and July 24, 2012. Thirteen sample locations were collected from dry drainages in Area III. Four locations were collected within the Silvernale Pond under water ranging from 3.2 feet to 5.3 feet. Sample locations for the Phase 3 drainage sediment samples within Area III are shown on Figure 2-1.

Table 2-1 includes the data gap rationale for sampling at each Phase 3 drainage sediment sample location, the location description, sample numbers, sample type, date of sample collection, chemical and radiological analyte, and description of sample. All locations and proposed samples were collected.

All sediment sampling equipment (described in Sections 2.1 and 2.2) that came into contact with sample materials was decontaminated prior to sample collection in accordance with SSFL SOP 12 of the Master FSP. All sediment samples were screened for radioactivity using a Micro R Survey Meter (for gamma radiation) and a Pancake Frisker Detector (for alpha and beta radiation), followed by screening with a photoionization detector (PID) as directed in SOP 7. For each sample collected, the site geologist also completed a field data sample sheet (FSDS) in accordance with SSFL SOP 8. The completed form was reviewed by the field sampler and sample coordinator during sample processing. A boring log was created in accordance with SSFL SOP 9 for each location and reviewed by a state certified Professional Geologist. Silvernale pond samples were collected in accordance with SOP 19, *Sediment Sampling from Standing Water*. The FSDS sheets and associated boring logs are presented in Appendix H.

2.1 Dry Drainage Surface Sampling

Prior to the collection of the Phase 3 dry drainage sediment samples within Area III, the surface of each sample area was prepared by CDM Smith sampling personnel by removing leaves, grass, and any other surface debris. Sediment samples were collected at 13 locations from the ground surface to 6 inches below ground surface (bgs) using a slide hammer equipped with a 2-inch diameter and 6-inch long stainless steel sample liner in accordance with SSFL SOP 2 of the Master FSP. The slide hammer sampler was pounded into the soil until the top of the sampler was flush with the ground surface and then removed from the soil. The sample sleeve was removed from the sampler and both ends capped with a Teflon® liner and a plastic cap.

After the samples were collected and labeled "Top" and "Bottom," adhesive sample labels, completed with all sampling information, were affixed to all sample sleeves and jars. The sample jars were then placed into plastic zip top bags and stored in a cooler with double bagged ice until the samples were relinquished to the project sample coordinator or field team leader (FTL). Each surface sample was analyzed for the methods identified at each sample location as indicated in Table 1 of the Phase 3 Drainage Sediment Area III Data Gap Analysis TM and Table 2-1 of this TM.

Sediment samples intended for radionuclide analyses by USEPA were placed by CDM Smith in one-gallon zip lock baggies provided by USEPA. Upon acceptance of the soil material, USEPA was responsible for sample management and shipment to their radionuclide laboratory (GEL).

2.2 Silvernale Pond Sediment Sampling

Pond sediment samples were collected at four locations within the Silvernale Pond from a rowboat using a Petite Ponar Sampler in accordance with SSFL SOP 19 of the Master FSP. Prior to sampling, the Ponar sampler, rowboat, and all necessary equipment were decontaminated in accordance with Section 5 of SSFL SOP 19. Each sample location was determined to be free of obstructions underwater and depth of water was measured and recorded. The Petite Ponar Sampler was lowered from the rowboat to the pond bottom by a clean Teflon-coated wire rope and sediment was collected in the sampler via a mechanism that closes the sampler jaws to trap sediment. The sampler was carefully lifted from the pond bottom and contents emptied into a stainless steel pan.

Soil for total petroleum hydrocarbons (TPH) analysis was removed directly from the Ponar sampler prior to emptying and placed in a separate 8-ounce jar. All of the remaining sediment was collected from the pan and placed into glass jars (ranging from 4 ounces to 16 ounces depending on volume of soil needed for the required analyses). Adhesive sample labels were filled out with all sampling information and affixed to each sample jar. The sample jars were then placed into plastic zip top bags. All jars were placed in a cooler with double bagged ice.

2.3 Sample Handling

All soil samples were relinquished by the field sampler or geologist to CDM Smith's FTL or sample coordinator. The FTL or sample coordinator reviewed the completed FSDS for each submitted soil sample and ensured that the sample labels were legible and correct and that they matched the information on the FSDS. Any discrepancies were discussed with the field samplers and corrections to the sample labels and/or FSDS were made as needed. All sample labels were covered with clear tape and the sleeves and jars placed back into their plastic zip top bag and refrigerated.

All sampling information on the FSDS was input into the Scribe electronic database by the sampling coordinator and one or more chain-of-custody (CoC) forms were generated at the end of the day from the database. The FTL reviewed each CoC, corrected any discrepancies, and reprinted the CoC, as needed. All CoCs for the Phase 3 drainage sediment samples within Area III are presented in Appendix I. Each completed CoC was signed by the sampler and the FTL as the individual responsible for release of the samples to the courier. All samples were packed into coolers and shipped in accordance with SSFL SOP 11.

USEPA was responsible for the management and shipping of the sediment material identified for radionuclide analysis.

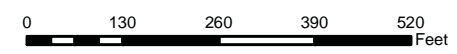


Area III Sediment Sample Locations

Santa Susana Field Laboratory
Ventura County, California

Figure 2-1
CDM Smith

- Legend**
- Sample Location
 - Area IV Subarea
 - Area III Site Area
 - Removed Building



Aerial Source: Bing Maps, (c) 2010 Microsoft Corporation and its data suppliers

Table 2-1
Sediment Samples Collected within Area III - Phase 3

Location ID	Location Description	Rationale / Comments	Boring Total Depth (ft bgs)	Fill Description	Sample Date	Sample Type	Sample Number	Laboratory Analyses
A3_Sed_DG-1	Northeast portion of Area III, north of Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/18/12	Sediment	SL-001-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-2	Northeast portion of Area III, north of Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	Trace gravel (igneous) at surface	7/18/12	Sediment	SL-002-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-3	Northeast portion of Area III, north of Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/18/12	Sediment	SL-003-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-4	Within Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/24/12	Sediment (Pond)	SL-004-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-5	Within Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/24/12	Sediment (Pond)	SL-005-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-6	Within Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/24/12	Sediment (Pond)	SL-006-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-7	Within Silvernale pond.	Receives surface water runoff from the Old Conservation and New Conservation Yards and the SRE Pond in Subarea 6 of Area IV.	0.5	None indicated	7/24/12	Sediment (Pond)	SL-007-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-8	North central portion of Area III, northwest of Silvernale pond on drainage exiting the south central portion of Subarea 5A.	Receives surface water runoff from operational areas in eastern portion of Area IV.	0.5	None indicated	7/18/12	Sediment	SL-008-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-9	West central portion of Area III. Drainage exiting the south central portion of Subarea 5B.	Receives surface water runoff from Area IV Subarea 5B, through 17th Street Pond. This location adjacent to 5B_DG-798 identified in Table 3 of Subarea 5B Phase 3 Data Gap Analysis for future collection.	0.5	None indicated	7/18/12	Sediment	SL-009-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-10	South of location A3_Sed_DG-9.	Receives surface water runoff from Area IV Subarea 5B, through 17th Street Pond. This location adjacent to 5B_DG-798 identified in Table 3 of Subarea 5B Phase 3 Data Gap Analysis for future collection.	0.5	None indicated	7/18/12	Sediment	SL-010-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-11	Northwestern portion of Area III. Drainage exiting the south central portion of Subarea 5B.	Receives surface water runoff originating from PDU and Building 4006 area in Subareas 5B and 5C of Area IV.	0.5	None indicated	7/17/12	Sediment	SL-011-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-12	Northwestern portion of Area III. Drainage exiting southeast portion of Subarea 5C.	Receives surface water runoff from most of Area IV Subareas 5B and 5C. This location identified in Table 3 of Subarea 5C Phase 3 Data Gap Analysis as 5C_DG-749 for future collection.	0.5	None indicated	7/17/12	Sediment	SL-012-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-13	Northwestern portion of Area III. Drainage originating north of Building 4015, and exiting the southeastern portion of Subarea 5C.	Receives surface water runoff from Area IV Subarea 5C only. This location identified in Table 3 of Subarea 5C Phase 3 Data Gap Analysis as 5C_DG-748 for future collection.	0.5	None indicated	7/17/12	Sediment	SL-013-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-14	Northwestern portion of Area III.	Receives surface water runoff from the four drainages on which locations 11, 12, 13, and 15 are located. This location is slightly updrainage of 5C_DG-511 identified in Table 3 of Subarea 5C Phase 3 Data Gap Analysis for future collection.	0.5	Trace gravel (igneous) at surface	7/17/12	Sediment	SL-014-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate

Table 2-1
Sediment Samples Collected from Subarea III - Phase 3

Location ID	Location Description	Rationale / Comments	Boring Total Depth (ft bgs)	Fill Description	Sample Date	Sample Type	Sample Number	Laboratory Analyses
A3_Sed_DG-15	Northwestern corner of Area III.	Receives surface water runoff from Area IV Subarea 5C only. This location identified in Table 3 of Subarea 5C Phase 3 Data Gap Analysis as 5C_DG-753 for future collection.	0.5	Trace gravel (igneous) at surface	7/17/12	Sediment	SL-015-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls, perchlorate
A3_Sed_DG-16	Western portion of Area III.	Receives surface water runoff from areas of surface disturbance and possible container storage in Area IV Subarea 5D.	0.5	None indicated	7/17/12	Sediment	SL-016-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
				None indicated	7/17/12	Sediment (duplicate)	SL-316-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls
A3_Sed_DG-17	Western portion of Area III.	Receives surface water runoff from areas of surface disturbance from the former borrow site.	0.5	None indicated	7/17/12	Sediment	SL-017-A3-SB-0.0-0.5	PAHs, PCBs/PCTs, dioxins, metals, TPH-EFH, terphenyls

NOTES:

Metals include mercury

PAHs = polycyclic aromatic hydrocarbons

PCBs/PCTs = polycyclic biphenyls/polycyclic triphenyls

PDU = Process Development Unit

SRE = Sodium Reactor Experiment

TPH-EFH = total petroleum hydrocarbons-extractable fuel hydrocart

ft bgs = foot below ground surface

2.4 Field Quality Control Procedures

Quality control (QC) samples collected in the field included field duplicates, matrix spike (MS)/matrix spike duplicate (MSD) samples, equipment rinsate blanks, and field blanks. Trip blanks filled with laboratory analyte-free water were sent to the site from the laboratory and were submitted unopened with any samples to be analyzed for TPH-extractable fuel hydrocarbons (EFH).

2.4.1 Field Duplicates and MS/MSD Samples

Both the field duplicates and MS/MSD samples were to be collected at a frequency of one per 20 parent soil samples collected. The field duplicate and MS/MSD samples are collected from the same location. The field duplicate samples were submitted to the laboratory as separate blind samples having a unique sample number different from the parent samples. The MS/MSD samples are additional volume of the parent samples collected in double or triple volume depending on the amount of soil needed by the analytical laboratories.

A total of 17 Phase 3 drainage sediment samples in Area III were collected. One MS/MSD and field duplicate sample were collected and submitted to the laboratory for analysis meeting the one per 20 criteria.

2.4.2 Equipment Rinsate Blank Samples

Equipment rinsate blanks were collected weekly for the sediment samples.

2.4.3 Field Blank Samples

Field blanks were collected once for each lot number of ASTM International Type II water that was used for decontamination. One field blank was collected during Phase 3 drainage sediment sampling within Area III.

2.4.4 Decontamination of Sampling Equipment

All sampling equipment was decontaminated by CDM Smith staff before and after completing each sample. This included the hand auger equipment, slide hammer equipment, the rowboat, Petit Ponar Sampler, rope, waders worn by staff, and other sampling equipment. All sampling equipment was cleaned with the triple rinse method described below between sampling of different depths at one location and between locations. The external surfaces of the equipment were washed with potable water and Alconox, or equivalent laboratory-grade detergent. Equipment was scrubbed until all visible dirt, grime, grease, oil, loose paint, rust flakes, etc., was removed. The equipment was then rinsed with potable water.

Any surface sampling equipment that came into contact with soil, including the auger bucket and the slide hammer sampler cup and the cap that holds the stainless steel sleeves in place while sampling were decontaminated as follows:

- Washed with a solution of potable water and Liquinox, or equivalent laboratory-grade detergent
- Rinsed thoroughly with potable water
- Given a final rinse with ASTM International Type II water

If the sampling device was not used immediately after being decontaminated, it was placed in a sealed plastic bag.

2.5 Chemical Laboratory Analytical Methods

The Phase 3 drainage sediment samples within Area III were analyzed using at least one of the following analytical methods:

- Metals using USEPA Methods 6020, 7471A (mercury)
- Soil pH using USEPA Method 9045D
- Polycyclic aromatic hydrocarbons (PAHs) and n-Nitrosodimethylamine (NDMA) using Method 8270C selective ion monitoring (SIM)
- Polychlorinated biphenyls (PCBs)/Polychlorinated triphenyls (PCTs) using USEPA Method 8082
- Dioxins/furans using USEPA Method 1613B
- Perchlorate using USEPA Method 6850
- Formaldehyde using USEPA Method 8315A
- Terphenyls using USEPA Method 8015B
- TPH EFH using USEPA Method 8015B EFH

All of the samples to be analyzed for terphenyls and dioxins were shipped to Lancaster Laboratories, Inc. (LLI) in Lancaster, Pennsylvania. Samples to be analyzed for all other analyses were submitted to EMAX Laboratories, Inc. (EMAX) located in Torrance, California. LLI and EMAX were selected as a result of competitive procurement during the Phase 1 sampling in Area IV.

2.6 Radiological Analytical Methods

USEPA was responsible for procuring and managing the radiological laboratory. The laboratory performing the radiological analyses was GEL LLC of Charleston, South Carolina. Radionuclides by method classification are listed below.

- Gamma Spectroscopy
 - Actinium-227, Actinium 228, Silver-108, Silver-108m, Barium-133, Barium-137m, Bismuth-212, Bismuth-214, Cadmium-113, Californium-249, Cobalt-60, Cesium-134, Cesium-137, Europium-152, Europium-154, Holmium-166, Potassium-40, Sodium-22, Niobium-94, Neptunium-236, Neptunium-239, Proactinium-231, Lead-212, Lead-214, Radon-220, Radon-222, Antimony-125, Tin-126, Tellurium-125m, Thorium-234, Titanium-208, and Thulium-171
- Alpha Spectroscopy 1
 - Americium-243
- Alpha Spectroscopy 2
 - Americium 241, Curium-243, Curium-244, Curium-245, Curium-246

- Alpha Spectroscopy 3
 - Uranium-233, Uranium-234, Uranium-235, Uranium-236, Uranium-238
- Alpha Spectroscopy 4
 - Thorium-228, Thorium-230, Thorium-232, Thorium-229
- Alpha Spectroscopy 7
 - Plutonium-236, Plutonium-238, Plutonium-239, Plutonium-240, Plutonium-244
- Liquid Scintillation 3
 - Strontium 90, Yttrium-90
- Liquid Scintillation
 - Tritium
- Liquid Scintillation 8
 - Carbon-14
- Liquid Scintillation 6
 - Nickel-63, Nickel-59
- Liquid Scintillation 5
 - Technetium-99
- Liquid Scintillation 4
 - Iodine-129
- Liquid Scintillation 1
 - Promethium-147

2.7 Chemical Data Review Processes

Analytical data produced by the laboratories (LLI and EMAX) were subject to multiple review steps to coincide with the start of distinct tasks. These steps were performed in a timely manner to ensure appropriate feedback and correction of errors. These steps included:

- Cross-reference check of sample CoC documents against the laboratory acknowledgement of sample receipt form. The laboratory acknowledgement of sample receipt was typically transmitted to the data manager via e-mail 2 to 3 days after sample receipt and login and includes a summary of the requested analyses to be performed per sample. Sample log-in errors were identified and corrected at this step.
- Tracking of sample collection, receipt, and laboratory sample delivery group (SDG) numbers on a sample tracking spreadsheet. This spreadsheet also includes field QC sample information, sample location coordinates, and required laboratory deliverables including reports, electronic data deliverables, raw data, and the status of validation.

Upon receipt of the laboratory report (delivered via e-mail), a preliminary review of the data was performed. This review consisted of:

- Reconciliation of the reported analyses against the analyses that were requested on the CoCs.

- Review of the laboratory case narratives. The case narrative identifies and explains quality issues encountered during the analysis of the samples. Quality issues may include (but are not limited to) missed holding times, poor spike recoveries in matrix or batch-specific QC samples, instrument calibration exceedances, and blank contamination. The laboratory consults with the project chemists on these issues and receives instruction on how to proceed before reporting the sample results.
- Review of the laboratory-specific QC data. These data are provided by the laboratory in summary form. Any unanticipated deviations from the project or method-specific criteria are reconciled with the laboratory at this stage.

2.8 Radionuclide Data Review Processes

USEPA was responsible for data review and validation of the radionuclide data. USEPA's data review process is described in *Quality Assurance Project Plan for Groundwater, Surface Water, and Sediment, Area IV Radiological Study, Santa Susana Field Laboratory, Ventura County, California* (HydroGeologic, Inc. 2010). Further details regarding the radiological data review process is provided in Appendix E.

2.9 Deviations from the Master FSP

The deviations from the Master FSP are described below.

2.9.1 Field Sampling

Global Positioning System (GPS) points were not collected for the sample locations on Silvernale Pond due to equipment difficulties. It was determined to be unsafe to take the 6-foot antenna in the rowboat to the sampling locations. The handheld unit was taken on the rowboat to each sample location, but was unable to connect to sufficient satellites to record coordinates for each point. Locations were recorded visually on a map by the FTL with the mapped location information transferred to the GIS data managers for incorporation into the database. The locations in the database therefore reflect the general location of the sample.

2.9.2 Analytical

No analytical deviations were required for the Phase 3 drainage sediment sampling activities within Area III.

Section 3

Area III Sediment Sampling Results - Chemical

Because this TM only provides the analytical results, data in this section are presented in a summary fashion. Table 3-1 summarizes the results for the Phase 3 drainage sediment surface sample data collected within Area III. The table details the chemicals analyzed, their chemical abstract service (CAS) number and frequency of detection, the minimum and maximum detected concentrations, the range of observed detection limits and reporting limits (RLs), and the sample location where the maximum concentration of each analyte was detected. If two locations for the maximum concentration are listed and only one maximum concentration value is provided, this indicates that the concentration was the same at the specified depth at both locations.

When Phase 3 sampling is complete, DOE will prepare Chemical Data Summary Reports that will evaluate the totality of information collected for Area IV, the Northern Buffer Zone, and adjacent areas. In these reports, DOE will describe the completeness of the investigations and present areas where data illustrate exceedances of proposed cleanup levels, per the AOC requirements. The Chemical Data Summary Reports will form one basis of the Soil Remedial Action Implementation Plans that will describe the soil remedies.

Appendix A provides tables for all chemical validated data by analytical method and sample location. Data validation qualifier codes and their definitions are presented in these tables. Appendix B provides tables for all radionuclide validated data by analytical method and sample location. Data validation qualifier codes and their definitions are presented in these tables. Appendix C provides the summary analytical data reports as received from LLI and EMAX. Appendix D presents the data usability and assessment report (DUAR), which details specific qualifications of chemical sample results along with all validation reports. Appendix E presents the radionuclide validation report. Appendix F is the master database of all chemical sample results including the data validation "flags" (qualifiers). Appendix G is the master database of all radionuclide sample results including the data validation "flags" (qualifiers). Appendix H provides the FSDS and boring logs and Appendix I provides the CoC records for all of the samples submitted to EMAX and LLI.

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Group	Chemical	CAS No	Detection Frequency	Minimum Concentration	Maximum Concentration	Range of Method Detection Limit	Range of Method Reporting Limit	Unit	Location of Maximum Concentration	Lab of Maximum Concentration	Method of Maximum Concentration	Depth of Maximum Concentration
Dioxins	1,2,3,4,6,7,8-Heptachlorodibenzo-p-Dioxin	35822-46-9	17 / 17	21.9	2490 J *#	0.043 - 0.776	4.99 - 16.2	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	1,2,3,4,6,7,8-HPCDF	67562-39-4	17 / 17	4.15 J Z	421	0.0238 - 0.26	4.99 - 16.2	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Dioxins	1,2,3,4,7,8,9-HPCDF	55673-89-7	16 / 17	0.627 J Z	50.2	0.0317 - 0.334	4.99 - 16.2	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Dioxins	1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	39227-28-6	14 / 17	1.3 J Z	27.1	0.0339 - 0.411	4.99 - 16.2	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	1,2,3,4,7,8-HXCDF	70648-26-9	14 / 17	2.18 J Z	20.4	0.024 - 0.263	4.99 - 16.2	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Dioxins	1,2,3,6,7,8-Hexachlorodibenzo-p-Dioxin	57653-85-7	17 / 17	1.01 J Z	114	0.0363 - 0.417	4.99 - 16.2	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	1,2,3,6,7,8-HXCDF	57117-44-9	14 / 17	0.923 J Z	27.5	0.0218 - 0.248	4.99 - 16.2	ng/kg	A3_SED_DG-5	LL	1613B	0 - 0.5
Dioxins	1,2,3,7,8,9-Hexachlorodibenzo-p-Dioxin	19408-74-3	17 / 17	0.996 J Z	52.3	0.0339 - 0.408	4.99 - 16.2	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	1,2,3,7,8,9-HXCDF	72918-21-9	8 / 17	1.08 J Z	6.05 J Z	0.0259 - 0.293	4.99 - 16.2	ng/kg	A3_SED_DG-5	LL	1613B	0 - 0.5
Dioxins	1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	13 / 17	1.54 J Z	29.5	0.0217 - 0.145	4.99 - 16.2	ng/kg	A3_SED_DG-5	LL	1613B	0 - 0.5
Dioxins	1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	40321-76-4	13 / 17	1.02 J Z	11.8	0.0331 - 0.432	4.99 - 16.2	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	2,3,4,6,7,8-HXCDF	60851-34-5	14 / 17	1 J Z	40.8	0.0226 - 0.249	4.99 - 16.2	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Dioxins	2,3,4,7,8-PCDF	57117-31-4	10 / 17	1.35 J Z	17.4	0.0215 - 0.142	4.99 - 16.2	ng/kg	A3_SED_DG-5	LL	1613B	0 - 0.5
Dioxins	2,3,7,8-TCDD	1746-01-6	9 / 17	0.679 J Z	3.35	0.0312 - 0.224	0.998 - 3.24	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Dioxins	2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	9 / 17	0.769 J Z	67.9	0.0469 - 0.491	0.998 - 3.24	ng/kg	A3_SED_DG-5	LL	1613B	0 - 0.5
Dioxins	OCDD	3268-87-9	17 / 17	284	26400 J *#	0.0243 - 0.314	9.98 - 32.4	ng/kg	A3_SED_DG-14	LL	1613B	0 - 0.5
Dioxins	OCDF	39001-02-0	17 / 17	12.5	877	0.017 - 0.199	9.98 - 32.4	ng/kg	A3_SED_DG-6	LL	1613B	0 - 0.5
Mercury	Mercury	7439-97-6	6 / 17	0.0639 J Z	0.17 J Z	0.0504 - 0.144	0.101 - 0.288	mg/kg	A3_SED_DG-6	EMAX	7471A	0 - 0.5
Metals	Aluminum	7429-90-5	17 / 17	7400	26600	11.9 - 33.6	99 - 280	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Antimony	7440-36-0	17 / 17	0.156 J Z	0.93 J Z	0.099 - 0.28	0.495 - 1.4	mg/kg	A3_SED_DG-5	EMAX	6020	0 - 0.5
Metals	Arsenic	7440-38-2	17 / 17	3.14	10.6	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Barium	7440-39-3	17 / 17	49.4	175	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Beryllium	7440-41-7	17 / 17	0.281 J Z	1.26 J Z	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Boron	7440-42-8	12 / 17	2.73 J Z	12.1 J Z	2.47 - 6.99	4.95 - 14	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Cadmium	7440-43-9	17 / 17	0.182 J Z	3.35	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Calcium	7440-70-2	17 / 17	1430	36900	9.9 - 28	19.8 - 55.9	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Chromium	7440-47-3	17 / 17	10.6	47.5	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Cobalt	7440-48-4	17 / 17	3.25	17.8	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Copper	7440-50-8	17 / 17	6.23	51.3	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Iron	7439-89-6	17 / 17	13500	42700	9.9 - 28	99 - 280	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Lead	7439-92-1	17 / 17	5.96	35.8	0.099 - 0.28	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Lithium	7439-93-2	17 / 17	12.4	54.3	0.99 - 2.8	1.98 - 5.59	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Magnesium	7439-95-4	17 / 17	3150	9320	4.95 - 14	9.9 - 28	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Manganese	7439-96-5	17 / 17	115	695	0.247 - 0.699	0.495 - 1.4	mg/kg	A3_SED_DG-7	EMAX	6020	0 - 0.5
Metals	Molybdenum	7439-98-7	17 / 17	0.392 J Z	2.33	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-7	EMAX	6020	0 - 0.5
Metals	Nickel	7440-02-0	17 / 17	7.86	39.6	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Phosphorus	7723-14-0	17 / 17	195	785	5.94 - 16.8	11.9 - 33.6	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Potassium	9/7/7440	17 / 17	2010	4830	29.7 - 83.9	99 - 280	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Selenium	7782-49-2	4 / 17	0.276 J Z	0.746 J Z	0.198 - 0.559	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Silver	7440-22-4	16 / 17	0.056 J Z	39.8	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-6	EMAX	6020	0 - 0.5
Metals	Sodium	7440-23-5	17 / 17	57.4 J Z	552	49.5 - 140	99 - 280	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Strontium	7440-24-6	17 / 17	13.8	142	0.247 - 0.699	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Thallium	7440-28-0	17 / 17	0.137 J Z	0.407 J Z	0.0495 - 0.14	0.396 - 1.12	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Tin	7440-31-5	0 / 17	-	-	4.95 - 14	9.9 - 28	mg/kg				
Metals	Titanium	7440-32-6	17 / 17	583	1460	0.495 - 1.4	0.99 - 2.8	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Vanadium	7440-62-2	17 / 17	19.2	58.7	0.0495 - 0.14	0.495 - 1.4	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Zinc	7440-66-6	17 / 17	40.1	335	1.48 - 4.19	4.95 - 14	mg/kg	A3_SED_DG-4	EMAX	6020	0 - 0.5
Metals	Zirconium	7440-67-7	0 / 17	-	-	2.47 - 6.99	4.95 - 14	mg/kg				
Moisture Content	Moisture	MOIST	17 / 17	0.53	69.6	0.5 - 0.5	0.5 - 0.5	%	A3_SED_DG-4	LL	160.3M	0 - 0.5
PAHs	1,1'-Biphenyl	92-52-4	0 / 17	-	-	2.5 - 22	5.1 - 44	µg/kg				
PAHs	1-Methylnaphthalene	90-12-0	0 / 17	-	-	2.5 - 22	10 - 87	µg/kg				
PAHs	2-Methylnaphthalene	91-57-6	1 / 17	3.2 J Z	3.2 J Z	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Acenaphthene	83-32-9	0 / 17	-	-	2.5 - 22	10 - 87	µg/kg				
PAHs	Acenaphthylene	208-96-8	1 / 17	3 J Z	3 J Z	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Anthracene	120-12-7	3 / 17	3.7 J Z	6.1 J Z	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Azobenzene	103-33-3	0 / 17	-	-	2.5 - 22	5.1 - 44	µg/kg				
PAHs	Benzo(a)anthracene	56-55-3	7 / 17	5 J S, Z	27	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Benzo(a)pyrene	50-32-8	12 / 17	3.1 J Z	150	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Benzo(b)fluoranthene	205-99-2	16 / 17	3 J Z	220	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5

REVISED - Table 3-1
 Summary of Analytical Results for Chemicals - Validated Data
 Sediment Samples - Area III - Phase 3

Group	Chemical	CAS No	Detection Frequency	Minimum Concentration	Maximum Concentration	Range of Method Detection Limit	Range of Method Reporting Limit	Unit	Location of Maximum Concentration	Lab of Maximum Concentration	Method of Maximum Concentration	Depth of Maximum Concentration
PAHs	Benzo(e)pyrene	192-97-2	11 / 17	4.8 J Z	200	2.5 - 22	5.1 - 44	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Benzo(g,h,i)perylene	191-24-2	15 / 17	2.9 J Z	520	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Benzo(k)fluoranthene	207-08-9	6 / 17	3.1 J Z	27	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Chrysene	218-01-9	8 / 17	7.5 J S, Z	57	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Dibenzo(a,h)anthracene	53-70-3	4 / 17	2.9 J Z	31	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Fluoranthene	206-44-0	17 / 17	2.9 J Z	63	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-15	EMAX	8270C SIM	0 - 0.5
PAHs	Fluorene	86-73-7	0 / 17	-	-	2.5 - 22	10 - 87	µg/kg				
PAHs	Indeno(1,2,3-cd)pyrene	193-39-5	7 / 17	3.1 J Z	370	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Naphthalene	91-20-3	1 / 17	2.8 J Z	2.8 J Z	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	N-Nitrosodimethylamine	62-75-9	0 / 17	-	-	2.5 - 22	10 - 87	µg/kg				
PAHs	Phenanthrene	85-01-8	7 / 17	6.6 J Z	30	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PAHs	Pyrene	129-00-0	17 / 17	2.9 J Z	77	2.5 - 22	10 - 87	µg/kg	A3_SED_DG-9	EMAX	8270C SIM	0 - 0.5
PCBPCTs	Aroclor 1016	12674-11-2	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1221	11104-28-2	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1232	11141-16-5	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1242	53469-21-9	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1248	12672-29-6	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1254	11097-69-1	11 / 17	30	400	10 - 29	20 - 58	µg/kg	A3_SED_DG-17	EMAX	8082	0 - 0.5
PCBPCTs	Aroclor 1260	11096-82-5	11 / 17	15 J Z	190	10 - 29	20 - 58	µg/kg	A3_SED_DG-6	EMAX	8082	0 - 0.5
PCBPCTs	Aroclor 1262	37324-23-5	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 1268	11100-14-4	0 / 17	-	-	10 - 29	20 - 58	µg/kg				
PCBPCTs	Aroclor 5432	63496-31-1	0 / 17	-	-	20 - 58	40 - 120	µg/kg				
PCBPCTs	Aroclor 5442	12642-23-8	0 / 17	-	-	20 - 58	40 - 120	µg/kg				
PCBPCTs	Aroclor 5460	11126-42-4	7 / 17	23 J Z	110	20 - 58	40 - 120	µg/kg	A3_SED_DG-5	EMAX	8082	0 - 0.5
Perchlorate	Perchlorate	14797-73-0	0 / 7	-	-	2.59 - 2.71	5.19 - 5.42	µg/kg				
Terphenyls	m-Terphenyl	92-06-8	0 / 17	-	-	3 - 20	7 - 46	mg/kg				
Terphenyls	o-Terphenyl	84-15-1	0 / 17	-	-	3 - 20	7 - 46	mg/kg				
Terphenyls	p-Terphenyl	92-94-4	0 / 17	-	-	3 - 20	7 - 46	mg/kg				
TPH-EFH	EFH (C12-C14)	PHCC12C14	4 / 17	8.5 J Z	1400	2.5 - 7.3	5.1 - 15	mg/kg	A3_SED_DG-6	EMAX	8015B EFH	0 - 0.5
TPH-EFH	EFH (C15-C20)	PHCC15C20	4 / 17	80	1300	2.5 - 7.3	5.1 - 15	mg/kg	A3_SED_DG-6	EMAX	8015B EFH	0 - 0.5
TPH-EFH	EFH (C21-C30)	PHCC21C30	16 / 17	5.3	610	2.5 - 7.3	5.1 - 15	mg/kg	A3_SED_DG-6	EMAX	8015B EFH	0 - 0.5
TPH-EFH	EFH (C30-C40)	PHCC30C40	16 / 17	5.4 J Z	510	5.1 - 15	10 - 29	mg/kg	A3_SED_DG-5	EMAX	8015B EFH	0 - 0.5
TPH-EFH	EFH (C8-C11)	PHCC8C11	2 / 17	17	71	2.5 - 7.3	5.1 - 15	mg/kg	A3_SED_DG-6	EMAX	8015B EFH	0 - 0.5

µg/kg - microgram per kilogram

mg/kg - milligram per kilogram

ng/kg - nanogram per kilogram

J - Result is an estimated value

S - Surrogates outside of criteria

Z - Analytes reported below the reporting limits and above the method detection limit

*# - Unusual problems found with the quality control data. See validation reports in Appendix C for detail.

LLI - Lancaster Laboratories

EMAX - EMAX Laboratories

Section 4

Area III Sediment Sampling Results – Radionuclides

USEPA released the Area III sediment radionuclide data with the entirety of its documents presenting its radiological studies in December 2013. The Area III sediment documentation included the analytical and data review results, but not a formal report of the Area III investigation. The USEPA data are being reported here to complete the record for the combined chemical and radionuclide sampling of the Area III drainages and Silvernale Pond.

The sediment samples were analyzed by GEL Laboratories, LLC of Charleston, South Carolina. The data were reviewed and validated by The Palladino Company. The radionuclide validation report is included as Appendix E to this Report. The validated results are provided in Appendix B and G.

The sediment samples were analyzed for gamma spectroscopy emitters (Actinium-227/228, Silver 108m, Barium-133, Bismuth 212/214, Cadmium-113m, Californium-249, Cobalt 60, Cesium-134/137, Europium 152/154/155, Holmium-166m, Potassium 40, Sodium 22, Niobium-94, Neptunium-236/239, Proactinium-231, Lead-212/214, Antimony-125, Tin-126, Tellurium-125m, Thorium-234, Titanium-208, and Thulium-171), alpha spectroscopy emitters (Americium-241/243, Curium-243/244, Uranium-233/234/235/236/238, Thorium-228/229/230/232/234, Plutonium-238/239/240), Liquid Scintillation (Carbon-14, Iodine-129, Nickel-59/63, Promethium-147, Tectium-99, and Tritium), and Gas Flow Proportional Counting (Strontium/Yttrium-90).

Table 4-1 provides a summary of the radionuclides detected, frequency of detection, and the range of detected concentrations. Figure 2-1 illustrates the locations where the samples were collected in Area III.

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Table 4-1
Summary of Analytical Results for Radionuclides - Validated Data
Sediments in Area III

Group	Analyte	Detection Frequency	Minimum Activity Concentration	Count Uncertainty for Minimum Activity Concentration	Maximum Activity Concentration	Count Uncertainty For Maximum Activity Concentration	Minimum Detectable Concentration*	Range of Minimum Detectable Concentration	Range of Count Uncertainty	EPA Radiological Reference Concentrations ¹	Unit	Location of Maximum Activity Concentration
RADs	Ac-227	0 / 17	-	-	-	-	-	0.155 - 0.377	0.0464 - 0.112	0.205	pCi/g	
RADs	Ac-228	17 / 17	0.802	0.0341	2.18	0.0856	0.206	0.0745 - 0.206	0.0341 - 0.0858	2.68	pCi/g	SL-005-A3
RADs	Ag-108m	0 / 17	0.0208 J R	0.00879	0.0208 J R	0.00879	0.028	0.0125 - 0.0327	0.00394 - 0.0109	NE	pCi/g	
RADs	Am-241	15 / 17	0	0.00257	0.0135	0.0058	0.00524	0.00473 - 0.0251	0.00257 - 0.0086	0.0386	pCi/g	SL-013-A3
RADs	Am-243	8 / 17	0.00703	0.00524	0.0231	0.00738	0.0153	0.00635 - 0.0283	0.00412 - 0.0087	0.0252	pCi/g	SL-003-A3
RADs	Ba-133	0 / 17	0.0175 J R	0.00855	0.0182 J R	0.00877	0.0258	0.0159 - 0.0391	0.00547 - 0.0133	NE	pCi/g	
RADs	Bi-212	17 / 17	0.45	0.0686	1.78	0.173	0.279	0.101 - 0.279	0.0575 - 0.173	2.38	pCi/g	SL-005-A3
RADs	Bi-214	17 / 17	0.71	0.0266	2.08 Y	0.0799	0.0655	0.0251 - 0.0655	0.0266 - 0.0799	1.83	pCi/g	SL-005-A3
RADs	C-14	2 / 17	0.439	0.205	0.482	0.202	0.658	0.621 - 0.699	0.186 - 0.206	2.96	pCi/g	SL-015-A3
RADs	Cd-113m	0 / 17	-	-	-	-	-	104 - 241	30.4 - 75.8	3440	pCi/g	
RADs	Cf-249	0 / 17	0.0422 J R	0.0339	0.129 J R	0.0559	0.152	0.069 - 0.163	0.025 - 0.0743	NE	pCi/g	
RADs	Cm-243/Cm-244	10 / 17	0.00182	0.00316	0.0192	0.00767	0.0178	0.00492 - 0.0355	0.00315 - 0.0115	0.0396	pCi/g	SL-017-A3
RADs	Co-60	4 / 17	0.00818 J	0.00458	0.011 J	0.00559	0.0201	0.014 - 0.0361	0.00407 - 0.0107	0.0363	pCi/g	SL-002-A3
RADs	Cs-134	4 / 17	0.00648 J JSK	0.00407	0.0221 J JSK	0.0063	0.0145	0.0121 - 0.0331	0.00402 - 0.0116	0.0431	pCi/g	SL-010-A3
RADs	Cs-137	17 / 17	0.0166	0.00486	0.324 Y	0.0223	0.0383	0.0138 - 0.0383	0.00486 - 0.0228	0.225	pCi/g	SL-005-A3
RADs	Eu-152	0 / 17	-	-	-	-	-	0.0392 - 0.0922	0.012 - 0.0323	0.0739	pCi/g	
RADs	Eu-154	0 / 17	-	-	-	-	-	0.0759 - 0.209	0.023 - 0.0617	0.198	pCi/g	
RADs	Eu-155	15 / 17	0.0341 J JSK	0.017	0.215 SK	0.0469	0.0957	0.0541 - 0.123	0.017 - 0.0498	0.231	pCi/g	SL-005-A3
RADs	Ho-166m	0 / 17	-	-	-	-	-	0.0212 - 0.0582	0.00625 - 0.0168	0.0514	pCi/g	
RADs	I-129	1 / 17	0.0677 J	0.0285	0.0677 J	0.0285	0.165	0.123 - 0.208	0.0285 - 0.0561	2.42	pCi/g	SL-001-A3
RADs	K-40	17 / 17	16.9	0.826	23.3	1.01	0.151	0.0963 - 0.317	0.801 - 1.01	35.5	pCi/g	SL-016-A3
RADs	Na-22	0 / 17	-	-	-	-	-	0.0161 - 0.0421	0.00494 - 0.0127	0.0468	pCi/g	
RADs	Nb-94	4 / 17	0.00797 J JSK	0.00371	0.0283 J JSK Z	0.011	0.0387	0.0127 - 0.0387	0.00371 - 0.011	0.875	pCi/g	SL-005-A3
RADs	Ni-59	0 / 17	-	-	-	-	-	0.672 - 2.59	0.167 - 0.762	0.875	pCi/g	
RADs	Ni-63	1 / 17	0.566	0.236	0.566	0.236	0.77	0.752 - 1.3	0.222 - 0.384	1.34	pCi/g	SL-003-A3
RADs	Np-236	0 / 17	-	-	-	-	-	0.0299 - 0.0677	0.00916 - 0.0209	0.0599	pCi/g	
RADs	Np-239	0 / 17	-	-	-	-	-	0.106 - 0.247	0.0306 - 0.0739	0.167	pCi/g	
RADs	Pa-231	1 / 17	0.473 J J	0.257	0.473 J J	0.257	0.789	0.654 - 1.6	0.192 - 0.471	1.22	pCi/g	SL-009-A3
RADs	Pb-212	17 / 17	0.926	0.0418	2.61	0.118	0.0587	0.0264 - 0.0606	0.0418 - 0.125	3.11	pCi/g	SL-005-A3
RADs	Pb-214	17 / 17	0.802	0.0276	2.41 Y	0.0792	0.0659	0.0271 - 0.0659	0.0276 - 0.0792	1.96	pCi/g	SL-005-A3
RADs	Pm-147	0 / 17	-	-	-	-	-	6.21 - 7.5	1.79 - 2.18	14.5	pCi/g	
RADs	Pu-238	3 / 17	0	0.00284	0.0058	0.00579	0.00785	0.00536 - 0.0206	0.00284 - 0.0058	0.0254	pCi/g	SL-003-A3
RADs	Pu-239/Pu-240	7 / 17	0.00201	0.00347	0.0087	0.00647	0.00784	0.00408 - 0.0246	0.00347 - 0.008	0.023	pCi/g	SL-003-A3
RADs	Sb-125	1 / 17	0.025 J JSK	0.0125	0.025 J JSK	0.0125	0.0425	0.0359 - 0.0902	0.0107 - 0.0268	0.374	pCi/g	SL-014-A3
RADs	Sn-126	0 / 17	-	-	-	-	-	0.0135 - 0.0382	0.00419 - 0.0117	0.0309	pCi/g	
RADs	Sr-90	3 / 17	0.267	0.11	0.817	0.0911	0.156	0.142 - 0.347	0.0356 - 0.11	0.117	pCi/g	SL-016-A3
RADs	Tc-99	0 / 17	-	-	-	-	-	1.05 - 1.48	0.31 - 0.436	0.619	pCi/g	
RADs	Th-228	17 / 17	0.761	0.0747	2.07 J	0.162	0.29	0.0779 - 0.299	0.0746 - 0.162	4.27	pCi/g	SL-005-A3
RADs	Th-229	8 / 17	0.0301	0.0213	0.0839	0.0246	0.0487	0.0417 - 0.131	0.0193 - 0.0425	0.0741	pCi/g	SL-003-A3
RADs	Th-230	17 / 17	0.599	0.0626	1.65 J	0.126	0.099	0.0395 - 0.119	0.0623 - 0.126	2.38	pCi/g	SL-005-A3
RADs	Th-232	17 / 17	0.76	0.0693	1.95	0.0991	0.0367	0.0135 - 0.0778	0.0693 - 0.134	3.44	pCi/g	SL-004-A3
RADs	Th-234	17 / 17	1.02	0.121	3.46 Y	0.269	0.46	0.218 - 0.58	0.11 - 0.343	3.54	pCi/g	SL-004-A3
RADs	Tl-208	17 / 17	0.277	0.0162	0.834	0.0439	0.0361	0.0134 - 0.0361	0.0148 - 0.0439	NE	pCi/g	SL-005-A3
RADs	Tm-171	1 / 17	8.69 J J	4.23	8.69 J J	4.23	12.6	9.18 - 30.8	3.08 - 10.5	76.7	pCi/g	SL-005-A3
RADs	Tritium	5 / 17	2.96	1.8	4.43	1.88	5.96	5.38 - 5.96	1.54 - 1.88	8.59	pCi/g	SL-001-A3
RADs	U-233/U-234	17 / 17	0.48	0.0451	1.87	0.0987	0.075	0.0591 - 0.157	0.0451 - 0.134	2.18	pCi/g	SL-007-A3
RADs	U-235/U-236	16 / 17	0.0194	0.0146	0.136	0.0322	0.0428	0.0192 - 0.131	0.0146 - 0.0429	0.152	pCi/g	SL-005-A3

**Table 4-1
Summary of Analytical Results for Radionuclides - Validated Data
Sediments in Area III**

Group	Analyte	Detection Frequency	Minimum Activity Concentration	Count Uncertainty for Minimum Activity Concentration	Maximum Activity Concentration	Count Uncertainty For Maximum Activity Concentration	Minimum Detectable Concentration*	Range of Minimum Detectable Concentration	Range of Count Uncertainty	EPA Radiological Reference Concentrations ¹	Unit	Location of Maximum Activity Concentration
RADs	U-238	17 / 17	0.518	0.0517	1.75	0.0948	0.0547	0.0338 - 0.112	0.0461 - 0.118	1.96	pCi/g	SL-007-A3
RADs	Y-90	3 / 17	0.267	0.11	0.817	0.0911	0.156	0.142 - 0.347	0.0356 - 0.11	0.117	pCi/g	SL-016-A3

Notes:

* - Value is associated with Maximum Activity Concentration

Minimum Detectable Concentration (MDC): The MDC is the net concentration that has a specified chance of being detected. It is an estimate of the detection capability of a measuring protocol and is calculated before measurements are taken. The detection limit is the lowest net response level, in counts, that you expect to be seen with a fixed level of certainty, customarily 95%. The MDC is the detection limit expressed as an activity concentration. If the activity concentration in a sample is equal to the MDC, then there is a 95% chance that radioactive material in the sample will be detected.

Activity Concentration: The activity per unit mass or volume of the material in which the radionuclides are essentially uniformly distributed.

Count Uncertainty: Uncertainty is defined as the range of values within which the true value is estimated to reside. The uncertainty associated with a result shall be reported. Uncertainty is commonly used in the radiochemical analyses to express method and counting error. The estimate of possible uncertainty consists of systematic and random variability. Each contributing source of uncertainty is expected to be distributed over its range.

RADs = Radionuclides

pCi/g = picocuries per gram

J = The analyte was detected at the reported concentration: the quantitation is an estimate.

R = The result is rejected due to serious deficiencies in the ability to analyze the sample and meet the quality control criteria.

K = Analyte present. Reported value may be biased high. Actual value is expected to be lower.

S = Analyte result is subject to spectral interference. Unless otherwise qualified the data may be used for its intended purpose provided that on-site analyses use the same gamma spectrometry library and follow the same analytical protocols.

Y = Result has been confirmed and has been qualified with a Y flag.

Z = Result has not been confirmed and has been qualified with a Z flag.

1 = USEPA Radiological Reference Concentrations as provided in *Development and Use of Radiological Reference Concentrations* November 2012

NE = No Radiological reference concentration established by USEPA

Section 5

Chemical Data Usability Assessment

The purposes of the DUAR provided in Appendix D and summarized here are to: (1) describe the data validation processes performed on the chemical data sets¹ and (2) determine whether the sample results meet the data quality objectives (DQOs) outlined in the Phase 3 Master FSP (CDM Smith 2012a) and QAPP (CDM Smith 2012c).

5.1 Usability Summary

For the Phase 3 drainage sediment Area III chemical data usability assessment, eight data sets, or SDGs, were reviewed via one or more independent processes. An SDG consists of 20 or fewer samples grouped together by analytical method for analyses based on when the samples were received by the laboratory. The analyses performed are discussed in Section 2.5.

Samples were collected and analyzed in accordance with the Master FSP (CDM Smith 2012a), and Addendum to the Master FSP for Phase 3 drainage sediment sampling within Area III with the exception of deviations during the field investigation as stated in Section 2.9.

The validated data for Phase 3 drainage sediment samples within Area III are usable as reported. No sample results were rejected during validation. Specific details are provided in the validation reports in Appendix C and Section 5.7.

5.2 Data Validation Procedures

Data were validated by the independent data validation firm Laboratory Data Consultants, Inc. All data validation was conducted in accordance with *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 2004), *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review* (EPA 2008), and *EPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dioxin/Furan Data Review* (EPA 2005).

The data validation strategy followed planning documents with 10 percent of the data validated according to USEPA Level IV protocols (all QC parameters and raw data) and the remaining 90 percent validated according to USEPA Level III protocols (all QC parameters except calibrations and raw data).

Table 5-1 presents all of the Phase 3 drainage sediment Area III SDGs and their corresponding level of validation (Level III or Level IV) and confirmatory review (described below). Some SDGs contain samples from other subareas, but all samples in an SDG were validated together. An index of samples associated with each SDG is presented at the beginning of Appendix D.

¹ The data review of the USEPA radionuclide data is provided in Appendix E. No further review of the radionuclide results is provided in this TM.

Table 5-1 Sample Delivery Groups and Validation Levels for Phase 3 Drainage Sediment Samples within Area III

Sample Delivery Group	Level of Validation Performed	CDM Smith Review
12G123	Level III	
12G140	Level IV	Yes
12G198	Level III	
PH020	Level IV	
PH024	Level III	Yes
PT022	Level IV	Yes
PT024	Level III	
PT029	Level IV	Yes

Note: Some SDGs may contain samples from other subareas, but all samples in an SDG were validated together.

To evaluate the quality of the laboratory data and the validation process, CDM Smith's chemists reviewed 10 percent or greater of the Phase 3 drainage sediment Area III SDGs. The SDGs reviewed are chosen based on methods and level of validation performed by the validation firm. The purpose of the review was to identify any laboratory QC issues not identified by the validation firm or any discrepancies in validation procedures by the validation firm. No additional qualifiers were applied to the data based on CDM Smith's review. The results of this review are provided in Section 5.8.

5.3 Quality Assurance Objectives

Quality assurance (QA) objectives for measurement data are expressed in terms of precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). The QA objectives provide a mechanism for evaluating and measuring data quality.

A review of the collected data is necessary to determine whether or not DQOs established in the Master FSP (CDM Smith 2012a) have been met. The following data measurement tasks were evaluated:

- Specification and adherence to analytical method and reporting detection limit requirements
- Identification of the appropriate laboratory analytical QC requirements and verification that QC requirements were met
- Verification that measurement performance criteria (representativeness and completeness) for the data were met
- Verification that field procedures were followed, deviations were documented, and that a determination of impact on data quality as a result of these deviations were made

The data validation review determines if the collected data are of sufficient quality (except for the rejected results) to support their intended use.

5.4 Summary of Field and Laboratory QA Activities

CDM Smith completed sampling activities in the Phase 3 drainage sediment Area III sampling area in accordance with the approved Master FSP (CDM Smith 2012a) and Addendum to the Master FSP (CDM Smith 2012b). A total of 17 soil samples were collected from 17 locations in the Phase 3

drainage sediment Area III. Table 2-1 provides a summary of the samples collected and the laboratory analyses requested. Associated sampling QA activities are described below.

5.5 Field Quality QA/QC

The field QC samples were to be collected at a frequency of 1 per 20 samples (5 percent) for MS/MSDs and field duplicates. One MS/MSD and field duplicate sample were collected at one Phase 3 drainage sediment Area III locations; this met the required criteria.

Sections 2.4.2 and 2.4.3 discuss the field blank and equipment blanks collected in association with the Phase 3 drainage sediment Area III samples. During the validation process, qualifiers were applied as required. Field blank samples were collected from each lot number of ASTM International water used for decontamination. One field blank and two equipment blank samples were collected in the Phase 3 drainage sediment Area III. The analytical results for the field blank and equipment blanks are presented in Appendix D and a summary of the detected results is shown in Tables 5-2 and 5-3, respectively. Analytes detected above the RL are highlighted in yellow.

Table 5-2 Field Blank Results for Phase 3 Drainage Sediment Samples within Area III – Detected Results Only

FB-062012 A3-SED-DG-FB 6/20/2012			
Analyte	Units	Concentration/RL	Final Qualifier
1,2,3,4,7,8-Hexachlorodibenzo-p-Dioxin	pg/L	1.05/9.83	J
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	pg/L	0.97/9.83	J
Aluminum	mg/L	0.0271/0.1	J
Boron	mg/L	0.00916/0.01	J
Calcium	mg/L	0.0438/0.1	J
Copper	mg/L	0.00112/0.001	J

Notes:

Blank result greater than RL

RL = Reporting Limit

mg/L = milligram per liter

pg/L = picogram per liter

J = Result is an estimated value

Table 5-3 Equipment Blank Results for Phase 3 Drainage Sediment Samples within Area III – Detected Results Only

EB-071812 A3-SED-DG-EB 7/18/2012			
Analyte	Units	Concentration/RL	Final Qualifier
1,2,3,4,7,8-HxCDF	pg/L	0.594/10.5	J
1,2,3,7,8-Pentachlorodibenzo-p-Dioxin	pg/L	0.457/10.5	J
Acenaphthylene	µg/L	0.15/0.2	J
Boron	mg/L	0.00918/1.01	J
Copper	mg/L	0.000594/0.001	J
Naphthalene	µg/L	0.17/0.2	J

Table 5-3 Equipment Blank Results for Phase 3 Drainage Sediment Samples within Area III – Detected Results Only

EB-072412 A3-SED-DG-EB 7/24/2012			
Analyte	Units	Concentration/RL	Final Qualifier
Acenaphthylene	µg/L	0.21/0.19	
Aluminum	mg/L	0.0331/0.1	J
Boron	mg/L	0.00942/0.01	J
Calcium	mg/L	0.0262/0.1	J
Copper	mg/L	0.0018/0.001	
Manganese	mg/L	0.000742/0.001	J
Naphthalene	µg/L	0.23/0.19	
Sodium	mg/L	0.0521/0.1	J

Notes:

Blank result greater than RL

HxCDF = hexachlorodibenzofuran

RL = Reporting Limit

µg/L = microgram per liter

pg/L = picogram per liter

mg/L = milligram per liter

J = Result is an estimated value

No trip blank samples were collected during the Phase 3 drainage sediment Area III sampling activities as no volatile organic analyses utilizing Encore samples was required.

Data qualifications based on all blank detections and impacts to the data due to contaminants detected in the blanks are discussed in Section 5.7.3 and in the Appendix D validation reports. Temperature blanks were to be included with each shipment of samples. Based on validation results, all temperature blanks submitted with the Phase 3 drainage sediment Area III samples met criteria.

The number of field QC samples collected satisfies the minimum requirements for the Phase 3 drainage sediment Area III sampling program. Field QA/QC objectives were also attained through the use of appropriate sampling techniques.

5.6 Laboratory Quality QA/QC

Analytical QA/QC was assessed by laboratory QC checks, method blanks, sample custody tracking, sample preservation, adherence to holding times, laboratory control samples (LCSs), MSs, calibration recoveries, surrogates, tuning criteria, second column confirmations, internal standards, serial dilutions, laboratory duplicates, and interference check standards. All laboratory QC sample criteria met project requirements with the appropriate qualifiers applied as indicated in the data validation reports in Appendix D. No sample results were rejected.

5.7 Data Quality Indicators

This section summarizes the validation performed. Individual SDG validation reports with specific sample detail are provided in Appendix D.

Achievement of the DQOs was determined in part by the use of data quality indicators (DQIs) described in the DUAR in Appendix D. These DQIs for measurement data are expressed in terms of PARCCS. The DQIs provide a mechanism for ongoing control to evaluate and measure data quality throughout the project. These criteria are defined in the sections below.

5.7.1 Precision

Precision is the measurement of the ability to obtain the same value on re-analysis of a sample carried through the entire analytical process. The closer the measurement results are to each other, the greater the precision. Precision has nothing to do with accuracy or true values of the sample. Instead, it is focused on random errors inherent in the analysis that stem from the measurement process and are compounded by the non-homogeneous nature of some samples. Precision is measured by analyzing two portions of the sample (sample and duplicate) and then comparing the results. This comparison can be expressed in terms of relative percent difference (RPD). RPD is calculated as the absolute difference between the two measurements divided by the average of the two measurements.

$$\text{RPD} = \frac{[(A-B)/A+B]}{2} \times 100$$

The problem with this formula is that it depends on the average of the two measurements and the magnitude of the calculated RPD is intimately linked to the magnitude of the results. When sample results are close to the RL, the RPD is greater but does not necessarily indicate that the precision is out of control limits, just that the sample concentrations are low.

RPD as a measure of precision works very well in those cases where the same level of analyte is present in all samples; however, it does not work well as a quantitative tool when varying levels are present. Analysis of sample duplicates is valuable as a quantitative measure of precision but is not useful as a quantitative measure in environmental sample analyses. Another option that is used for evaluating the differences between sample results that are close to the RL is calculating the absolute difference between the results. In this situation, the difference between the sample results is compared to the RL (two times the RL for soils) and if the difference is greater, the sample results are qualified as estimated "J."

Because of these problems, precision is normally calculated on spike samples, either on a MS and MSD or on a LCS and laboratory control sample duplicate (LCSD). In this case, a known concentration of analyte has been created in each sample and long- and short-term evaluations of RPD can be made that are applicable to the reality of the measurement. The drawback is that the precision measurement is only applicable to the particular spike level used.

For the Phase 3 drainage sediment Area III data set, precision was evaluated by reviewing RPD results for MS/MSDs, LCS/LCSDs, laboratory duplicates, and field duplicates.

Laboratory RPD control limits are presented in the Master FSP (CDM Smith 2012a) or they are laboratory specific. For laboratory duplicates, if one or both of the sample results were less than two times the RL, a control limit of the absolute difference value equal to the RL was used for comparison.

The field duplicate RPD criterion is 50 percent. Field duplicates for this project were validated as follows: If one result is non-detect and the other result is above the RL, the RPD result is reported at 200 percent and the field duplicate sample and parent sample results are qualified as estimated "J" for a detect value or "UJ" for a non-detect value. If the field duplicate RPD is above the 50 percent criterion (and both sample results are above the RL) the field duplicate and parent sample results for that analyte are qualified as estimated "J."

Qualifiers were applied to applicable sample analyte results during the validation process based on laboratory and field duplicate precision results. Details of the validation and the number of analytes qualified are provided in the DUAR and laboratory validation reports in Appendix C.

No Phase 3 drainage sediment Area III individual analyte results required qualification based on precision criteria.

Field duplicate precision criteria required the qualification of one result for dioxins and one result for metals for Phase 3 drainage sediment Area III samples. No results were rejected based on field duplicate precision criteria. All field duplicate RPD results are presented in Appendix D. In summary, sample results that have been qualified as estimated "J/UJ" due to precision criteria are usable for project decisions but should be used with a degree of caution.

There was no discernible pattern or reason for the laboratory and field duplicate sample RPD exceedances identified. No field sampling issues were identified that would cause the RPD results that were outside of criteria. These exceedances are reasonable for this type of sampling activity.

5.7.2 Accuracy

Accuracy is a concept from quantitative analysis that attempts to address the question of how close the analytical result is to the true value of the analyte in the sample. Accuracy is determined through a spike procedure, where a known amount of the target analyte is added to a portion of the sample then the sample and the spiked sample are analyzed. The quantitative measure of accuracy is percent recovery (%R) calculated as follows:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

Each measurement performed on a sample is subject to random and systematic error. Accuracy is related to the systematic error. Attempts to assess systematic error are always complicated by the inherent random error of the measurement.

Analytical accuracy for the entire data collection activity is difficult to assess because several sources of error exist. Errors can be introduced by any of the following:

- Sampling procedure
- Field contamination
- Sample preservation and handling
- Sample matrix
- Sample preparation
- Analytical techniques

Accuracy is maintained to the extent possible by adhering to the USEPA method and approved field and analytical standard operating procedures.

The following QC samples are used to assess laboratory accuracy:

Matrix Spikes: MSs are samples with a known amount of a target analyte added to them. Analysis of the sample that has been spiked and comparison with the results from the unspiked sample (background) gives information about the ability of the test procedure to generate a correct result from the sample.

Post Digestion Spikes: Post digestion spikes are performed after the sample has been prepared and are ready for analysis. These are also termed "analytical spikes." The technique is used in conjunction with a MS to provide data that can separate interferences produced as part of the sample preparation from interferences that are innate qualities of the sample.

Laboratory Control Samples: LCSs consist of a portion of analyte-free water or solid phase sample that is spiked with target analytes at a known concentration.

Surrogates: Surrogate recovery is a QC measure limited to use in organics analysis. Surrogates are compounds added to every sample at the beginning of the sample preparation to monitor the success of the sample preparation and analytical procedures on an individual sample basis. Individual compounds used as surrogates are selected based on their ability to mimic the behavior of specific target analytes held to be particularly sensitive to the sample preparation manipulations.

Interference Check Samples: Interference check sample analysis is a QC measure unique to metals analysis using inductively coupled plasma (ICP) atomic emission spectrometry. This QC sample verifies the analytical instrument's ability to overcome interferences typical of those found in samples.

Calibrations: Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for metals. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing calibrations demonstrate that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

Internal Standards: Internal standards measure the gas chromatograph/ mass spectrometer sensitivity and response stability during each analysis.

Serial Dilution: Serial dilutions are performed on at least one sample from every batch of analyses for metals to determine if physical or chemical interferences exist in the analyte determinations.

For the Phase 3 drainage sediment Area III data set, accuracy was evaluated by reviewing the %R values and relative response factors of initial and continuing calibrations (percent difference or percent drift [%D] for organic analyses), internal standards, surrogate spikes (organic analyses only), MS/MSD, LCS/LCSD, ICP interferences, and by performing serial dilution checks during metals analyses, in conjunction with method blank, calibration blank, equipment rinsate blank, and trip blank results. These QC results assist in identifying the type and magnitude of effects that may have contributed to system error introduced from field and/or laboratory procedures.

Qualifiers were applied to applicable sample results during the validation process based on laboratory accuracy results. Details of the validation and the number of analytes qualified are discussed in detail in the DUAR and laboratory validation reports in Appendix D.

The following Phase 3 drainage sediment Area III individual analyte results were qualified as estimated "J/U" based on accuracy criteria:

- Some of the metals results due to MSs
- Some of the semi-volatile organic compound (SVOC) SIM results due to surrogates

- Some of the dioxin results based on confirmation %Ds

Sample preservation, handling, and holding times are additional measures of accuracy of the data. Holding times are defined as the amount of time that elapses between collection of the sample in the field to the start of the analysis. Preservation is defined as techniques used to maintain the target analytes at concentrations representative of the source sampled. Published holding times are viewed as valid as long as the associated preservation and container requirements have been met. All holding times, sample preservation, and handling criteria were met.

In summary, sample results that have been qualified as estimated "J/UJ" due to accuracy criteria are usable for project decisions.

5.7.3 Blank Contamination

Blanks are used to determine the level of laboratory and field contamination introduced into the samples, independent of the level of target analytes found in the sample source. Sources of sample contamination can include the containers and equipment used to collect the sample, preservatives added to the sample, other samples in transport coolers and laboratory sample storage refrigerators, standards and solutions used to calibrate instruments, glassware and reagents used to process samples, airborne contamination in the laboratory preparation area and the analytical instrument sample introduction equipment, and contamination in the field from cross contamination or engine exhaust. Each analyte group has its own particular suite of common laboratory contaminants. Active measures must be performed to continually measure the ambient contamination level and steps taken to discover the source of the contamination to eliminate or minimize the levels. Random spot contamination can also occur from analytes that are not common laboratory problems but that can arise as a problem for a specific project or over a short period of time. Sample equipment decontamination practices are discussed in Section 2.4.4. Field blanks, equipment blanks, trip blanks, and laboratory method blanks are analyzed to identify possible sources of contamination. The DUAR and laboratory validation reports in Appendix D discuss the results that were qualified based on field and laboratory blank contamination.

In summary, for Phase 3 drainage sediment Area III samples, 17 percent of the dioxin results were qualified as non-detect "U" due to laboratory blank contamination criteria. No other analytes were qualified as non-detect based on laboratory blank contamination.

For the dioxins, the method detection limits (MDLs) for this analysis are very low, reported in nanogram per kilogram (ng/kg) or parts per trillion, resulting in numerous results qualified as estimated "J." Many of these estimated values have been subsequently qualified as non-detect "U" because the compound was detected in related laboratory blanks. In the laboratory blanks, low level detections of dioxin analytes are somewhat inevitable because of the nature and universal extent of the compounds. The dioxin levels found in the blanks are well below site-related action levels. Therefore, the resulting qualification of associated sample results as not detected or "U" does not falsely diminish identification of site-related contaminants.

Tables 5-2 and 5-3 provide a summary of analytes observed in the field blank and equipment blank samples. Most of the detected compounds in the equipment blanks were below the RLs but above the method detection limits (MDLs). Compounds detected above the RL in field and equipment blanks are highlighted yellow in the associated tables.

ASTM International Type II water is not typically certified "clean" to the RLs established for the low level methods used for Phase 3 Area III sampling. As shown in Table 5-2, low levels of dioxin and metals were detected in the field blank; dioxin results were all below the RL. No analytes were qualified as non-detect based on field blank contamination. The evaluation of ASTM International Type II water used in the field will continue throughout the sampling program. The ASTM International Type II water is being analyzed before sampling starts to ensure that the decontamination water is as clean as possible.

A review of the Phase 3 drainage sediment Area III equipment blanks was also performed. In general, a variety of analytes were detected above their respective RLs. All Phase 3 equipment blanks will continue to be monitored to determine if these low level detections are consistent, thus indicating a possible deficiency in decontamination procedures and/or source water impacts that need to be addressed and corrected. No qualification of sample results for equipment blank contamination was required during the validation process. To date, chemical detections in equipment blank samples appear to be random occurrences.

5.7.4 Representativeness, Comparability, and Sensitivity

Representativeness, comparability, and sensitivity are achieved by using USEPA-approved sampling procedures and analytical methodologies. By following the procedures described in the Work Plan/Field Sampling and Analysis Plan (WP/FSAP) for this sampling event and future sampling events, sample analysis should yield results representative of environmental conditions at the time of sampling. Similarly, reasonable comparability of analytical results for this and future sampling events can be achieved if approved USEPA analytical methods and standardized reporting units are employed.

5.7.4.1 Representativeness

Representativeness is a qualitative term that expresses the degree to which the sample data accurately and precisely represent the environmental conditions corresponding to the location and depth interval of sample collection. Requirements and procedures for sample collection are designed to maximize sample representativeness.

Representativeness also can be monitored by reviewing field documentation and/or performing field audits. For this report, a detailed review was performed on the CoC forms, laboratory sample confirmation logs, and data validation packages. Laboratory QA/QC requirements were included in the WP/FSAP (CDM Smith 2012c) and laboratory statements of work (SOWs) to ensure that the laboratory analytical results were representative of true field conditions.

The most significant measure of representativeness is the accuracy of the sampling network and selection of appropriate locations and depths, etc. Field sampling accuracy was attained through adherence to the approved WP/FSAP for sample location and collection and by using approved SOPs for field data collection. Therefore, the data should represent, as near as possible, the actual field conditions at the time of sampling.

Representativeness has been achieved by the performed field work and laboratory analyses. The generated analytical data generated that have not been rejected are viewed to be a representative characterization of the project area.

5.7.4.2 Comparability

Comparability is a qualitative term that expresses the confidence with which a data set can be compared with another. Strict adherence to standard sample collection procedures, analytical detection limits, reporting units, and analytical methods assures that data from like samples and sample conditions are comparable. This comparability is independent of laboratory personnel, data reviewers, or sampling personnel. Comparability criteria are met for the project if, based on data review, the sample collection and analytical procedures are determined to have been followed, or defined to show that variations did not affect the values reported.

To ensure comparability of data generated for the site, standard sample collection procedures and DTSC-reviewed analytical methods were utilized by CDM Smith. The sample analyses were performed by LLI and EMAX. Utilizing such procedures and methods enables the current data to be comparable with previous and future data sets generated using similar methods.

5.7.4.3 Sensitivity

Sensitivity is related to the ability to compare analytical results with project-specific levels of interest, such as risk-based screening levels or action levels. Analytical detection limits for the various sample analytes should be below the level of interest to allow an effective comparison.

Detection Limits

The MDL study attempts to answer the question, "What is the lowest level of analyte in a sample that will result in a signal different than zero"? The study is based upon repetitive analysis of an interference-free sample spiked with a known amount of the target analyte. The MDL is a measure of the ability of the test procedure to generate a positive response for the target analyte in the absence of any other interference from the sample.

The RL is generally defined as the lowest concentration at which an analyte can be detected in a sample and its concentration reported with a reasonable degree of accuracy and precision. For samples that do not pose a particular matrix problem, the RL is typically about three to five times higher than the MDL.

Laboratory results are reported according to rules that provide established certainty of detection and RLs. The result for an analyte is flagged with a "U" if that analyte was not detected, or qualified with a "J" flag if associated QC results fall outside the appropriate tolerance limits. Also, if an analyte is present at a concentration between the MDL and the RL, the analytical result is flagged with a "J," indicating an estimated quantity. Qualifying the result as an estimated concentration reflects increased uncertainty in the reported value.

Qualifiers were applied to applicable sample results by the laboratory and identified during the validation process based on sample results being reported as detected below the RL/MDL. This does not indicate a deficiency with the data but simply that the results are below the RLs/MDLs. Details of the validation and the number of results qualified are discussed in detail in the DUAR and laboratory validation reports in Appendix D.

In summary, for all methods analyzed for Phase 3 drainage sediment Area III, results for some of the analytes were qualified as estimated due to RL criteria for dioxins, metals, mercury, TPH EFH, PCBs/PCTs and SVOC SIM results. For the data validated in this TM, RLs for the sample results were low enough to compare to the RLs stated in the WP/FSAP (CDM Smith 2012c).

5.8 Review of Selected Validation Reports

CDM Smith performed a review of the validation reports identified in Table 4-1. This review involved comparing the validation report results against the laboratory data packages as well as the validation guidance documents. All validation report results were verified against the laboratory data packages and validation guidance documents were followed as required.

5.9 Data Completeness

Completeness of the data collection program is defined as the percentage of samples planned for collection as listed in the WP/FSAP (CDM Smith 2012c) versus the actual number of samples collected during the field program (see equation A).

Completeness for acceptable data is defined as the percentage of acceptable data obtained judged to be valid versus the total quantity of data generated (see equation B). Acceptable data include both data that pass all the QC criteria (unqualified data) and data that may not pass all the QC criteria but had appropriate corrective actions taken (qualified but usable data).

$$\text{Equation A.} \qquad \qquad \qquad \% \text{Completeness} = Cx \frac{100}{n}$$

Where:

C = actual number of samples collected
n = total number of samples planned

$$\text{Equation B.} \qquad \qquad \qquad \% \text{Completeness} = Vx \frac{100}{n'}$$

Where:

V = number of measurements judged valid
n' = total number of measurements made

The overall completeness goal, as defined in the Master FSP (CDM Smith 2012a), for this sampling event is 90 percent for each analytical test for all project data.

A total of 18 Phase 3 drainage sediment Area III samples including the field duplicate were collected and analyzed. The completeness goal for the actual number of samples collected compared to the number of samples planned is considered acceptable.

The completeness goal achieved for acceptable data was 100 percent of the number of measurements judged to be valid versus the total number of measurements made for all Phase 3 drainage sediment Area III samples analyzed. Table 5-4 summarizes all results that were estimated.

Table 5-4 Summary of Data Completeness Following Data Validation – Phase 3 Drainage Sediment Area III

	Number of Analyte Detections Without Qualifiers	Number of Estimated Results	Number of Rejected Results	Number of Nondetect Results	Number of Estimated Nondetect Results	Total Analytes Detect and Nondetect	Percent of Analyte Results Judged Valid Versus Total Analyte Results Collected
Dioxins	146	90		52	1	289	100
Perchlorate-6850				7		7	100
Metals	359	98		40	13	510	100
Mercury		6		11		17	100
TPH EFH	38	4		43		85	100
Terphenyls				51		51	100
PCBs/PCTs	23	6		175		204	100
SVOCs SIM	48	85		199	42	374	100
Completeness Total for All Phase 3 Drainage Sediment Area III Samples Collected and Judged Valid							100

Sampling deviations from procedures described in the WP/FSAP (CDM Smith 2012c) are discussed in Section 2.9 of this TM. Deviations did not impact DQOs for this sampling event. The data reported are suitable for their intended use for characterization of Area IV of SSFL. The DQIs identified in the WP/FSAP (CDM Smith 2012c) met appropriate criteria. The completeness goals for both the locations sampled and the number of measurements judged to be valid were met or will be met. The achievement of the completeness goals for the data indicates a sufficient amount of usable data has been generated for project decisions.

5.10 Assessment of Data Usability and Reconciliation with WP/FSAP Goals

One hundred percent of the data validated for Phase 3 drainage sediment Area III, and reported in this TM, are suitable for their intended use for site characterization. No sample results were rejected. The RLs reported generally met the expected limits proposed by the analytical laboratory in their subcontract agreement with CDM Smith.

Sample results that were qualified as estimated are usable for project decisions. This data is considered usable.

Field duplicate precision also met criteria the majority of the time. RPDs were outside criteria predominantly when the sample results were close to the RL and/or below the project required action limits. Decisions based on results close to the RL should be made with a degree of caution. The achievement of the completeness goals for number of samples collected, and the number of sample results acceptable for use provides sufficient quality data to support project decisions.

Section 6

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