Department of Energy
Office of Legacy Management

May 17, 2010

Mr. Carl Spreng
RFLMA Project Coordinator
Colorado Department of Public Health and Environment
4300 Cherry Creek Drive South
Denver, CO 80246-1530

SUBJECT: Original Landfill Sampling and Analysis Plan (OLF SAP)

Dear Mr. Spreng:

This correspondence is to transmit the enclosed OLF SAP for your review and approval in accordance with the Rocky Flats Legacy Management Agreement Contact Record 2010-01.

We anticipate performing the field sampling work in the next few months so that we would have analytical results for evaluation before the end of this fiscal year.

I may be reached at (720) 377-9682 or Rick DiSalvo, at (720) 377-9674 Assistant Project Manager if you have any questions regarding the enclosed document.

Sincerely,

Scott R. Surovchak
LM Site Manager

RLD/abm

Enclosure

cc:
T. Pauling, DOE w/o enclosure
V. Moritz, EPA Region 8
R. DiSalvo, Stoller
L. Kaiser, Stoller w/o enclosure
rc-rocky.flats

LMS/RFS/S06391

Rocky Flats, Colorado, Site

Original Landfill Sampling and Analysis Plan

April 2010

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Abbreviations

ARAR	applicable or relevant and appropriate requirement
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
COC	chain of custody
CR	Contact Record
CRA	*Rocky Flats Site Comprehensive Risk Assessment*
H&S	Health and Safety
IDM	investigation-derived material
IH	industrial hygiene
IHSS	Individual Hazardous Substance Site
JSA	Job Safety Analysis
LCS	laboratory control sample
OLF	Original Landfill
OLF IM/IRA	*Final Interim Measure/Interim Remedial Action for the Original Landfill*
PCB	polychlorinated biphenyl
PPE	personnel protective equipment
PRG	preliminary remediation goal
QC	Quality Control
RCT	Radiological Control Technician
RFCA	*Rocky Flats Cleanup Agreement*
RFLMA	Rocky Flats Legacy Management Agreement
RFS	Rocky Flats Site
RWP	Radiological Work Permit
SAP	Sampling and Analysis Plan
SVOC	semi-volatile organic compound
VOC	volatile organic compound
WRW	Wildlife Refuge Worker

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1.0 Introduction

The closed Rocky Flats Site (RFS) Original Landfill (OLF) was operated from 1952 to 1968, essentially as a hillside dump used primarily for construction wastes.

This Sampling and Analysis Plan (SAP) describes planned soils sampling at the OLF using a Geoprobe unit for characterization of residual contamination. This work will provide preliminary data for evaluation of OLF soils' residual contamination levels for comparison to the 2008 Colorado Department of Public Health and Environment (CDPHE) policy regarding post-closure care termination criteria (CDPHE 2008).

This preliminary data will be evaluated to determine whether criteria for termination of certain OLF monitoring and maintenance activities can be met. The results of the evaluation will include recommendations on whether to pursue termination of specific post-closure care requirements and will propose the additional characterization, if any, to perform assessments in support of the termination of requirements.

The SAP provides information on the data quality objectives, sample location selection methodology, and analytes and quality assurance/quality control for the characterization work. The SAP also describes the project organization, tasks, health and safety requirements, and investigation-derived material (IDM) disposition for the sampling activities.

2.0 Regulatory Framework

Closure of the OLF was completed in accordance with the March 10, 2005, *Final Interim Measure/Interim Remedial Action for the Original Landfill* (OLF IM/IRA) (DOE 2005). The OLF IM/IRA addressed the OLF, former Individual Hazardous Substance Site (IHSS) 115, and former IHSS 196, the Filter Backwash Pond, which was located approximately in the center of the western half of the OLF. The closure involved removal of uranium "hot spots," soil grading, groundwater collection and drainage features, and construction of a 2-foot-thick clean soil cover with diversion and drainage features designed to promote hillside stability and control surface-water run on and run off. The closed OLF is subject to certain Colorado Hazardous Waste Act (CHWA) Regulations (6 CCR 1007-3 Part 265, Subpart G) post-closure monitoring and maintenance requirements. While the OLF is not a hazardous waste landfill, these CHWA requirements are identified as applicable or relevant and appropriate requirements (ARARs) in the final Corrective Action Decision/Record of Decision (CAD/ROD) for RFS (DOE, EPA, CDPHE 2006). Under these ARARs, the generally applicable post-closure care period for a closed unit, such as a landfill, is 30 years; however, this period may be shortened or extended based on evaluation criteria described in the CDPHE policy.

Pursuant to the CDPHE policy, post-closure care of hazardous waste landfills may be reduced or eliminated based on a demonstration that the closed unit does not pose a significant threat to human health and the environment. The CDPHE policy criteria include whether a closed unit may meet "clean closure" standards, or whether a performance-based evaluation shows the closed unit does not pose a threat for which post-closure care is needed.

Relevant to the planned soil characterization described in this SAP, the performance-based criteria include whether the waste is and will continue to be stable, and if a release were to occur whether the anticipated impact to human health and the environment would be minimal and may not justify an active response. The "clean closure" standards are based on residential/unrestricted use soil screening contamination levels specified by the CDPHE policy.

The OLF IM/IRA is based upon pre-closure residual soil contamination data that were generated in the early 1990s. These data are now between 15 years and 19 years old. Natural attenuation of some contaminants and the impacts from regrading the surface of the OLF for closure are expected to have reduced residual contamination levels. Also, a uranium "hot spot" removal action just prior to installing the soil cover reduced radionuclide contamination levels. None of these effects are reflected in the data from the early 1990s that form the basis for the OLF IM/IRA.

Thus, it will be helpful and informative to the post-closure care termination criteria evaluation to collect soil characterization data reflecting current conditions to supplement the existing OLF IM/IRA data. The results will also help focus the timing and extent of any additional sampling and analysis that may further inform the evaluation.

Soil sampling locations utilized in the OLF IM/IRA are shown in Figure 1. As would be expected, the spatial coverage for the subsurface samples is not as extensive as that for the surface samples. The surface sample locations have been reworked during closure of the OLF, and are now below at least 2 feet of clean soil that comprise the OLF closure cover.

These OLF IM/IRA residual soil contamination data were compared to the CDPHE policy screening levels and to the surface soil Wildlife Refuge Worker (WRW) preliminary remediation goals (PRGs) developed for evaluation of remedial alternatives prior to selection of the final remedy in the CAD/ROD. The results are shown in Table 1 for surface soils and Table 2 for subsurface soils.[1]

As shown in Table 1 and Table 2, several analytes have results that exceed the CDPHE policy screening levels at many sample locations. Notably, the arsenic, semivolatile organic compound (SVOC) and polychlorinated biphenyl (PCB) analytes have a high frequency of results exceeding the CDPHE policy screening levels. But, except for arsenic, the frequency of exceeding the WRW PRG is much smaller. Arsenic is ubiquitous in the Rocky Flats soils, and the range of concentrations shown in Table 1 and Table 2 are similar to the soil sample results for the Rocky Flats Site in general. The CAD/ROD summarizes the evaluation of arsenic concentrations in soil, which concluded that the exposure risk from measured arsenic levels at Rocky Flats is about the same as the exposure risk posed by background arsenic concentrations.

Also as shown in Table 1 and Table 2, essentially the same analytes with results exceeding the CDPHE policy screening levels also exceeded WRW PRGs, but with a much lower frequency.

[1]Tables 1 and 2 are derived from the OLF IM/IRA soils data summary tables, Tables 4-1 and 4-2, but present the results differently than the IM/IRA data tables. The IM/IRA soils data summary tables include data for analytes that were detected above background and the method detection limit and that had a WRW land use *Rocky Flats Cleanup Agreement* (RFCA) (DOE, EPA, CDPHE 1996) surface soil action level. At the time of the IM/IRA, WRW PRGs were not yet calculated and approved. The PRGs are approximately an order of magnitude below the surface soil WRW RFCA action levels. The WRW PRGs also include levels for subsurface soil, but a comparison to surface soil PRGs is more conservative.

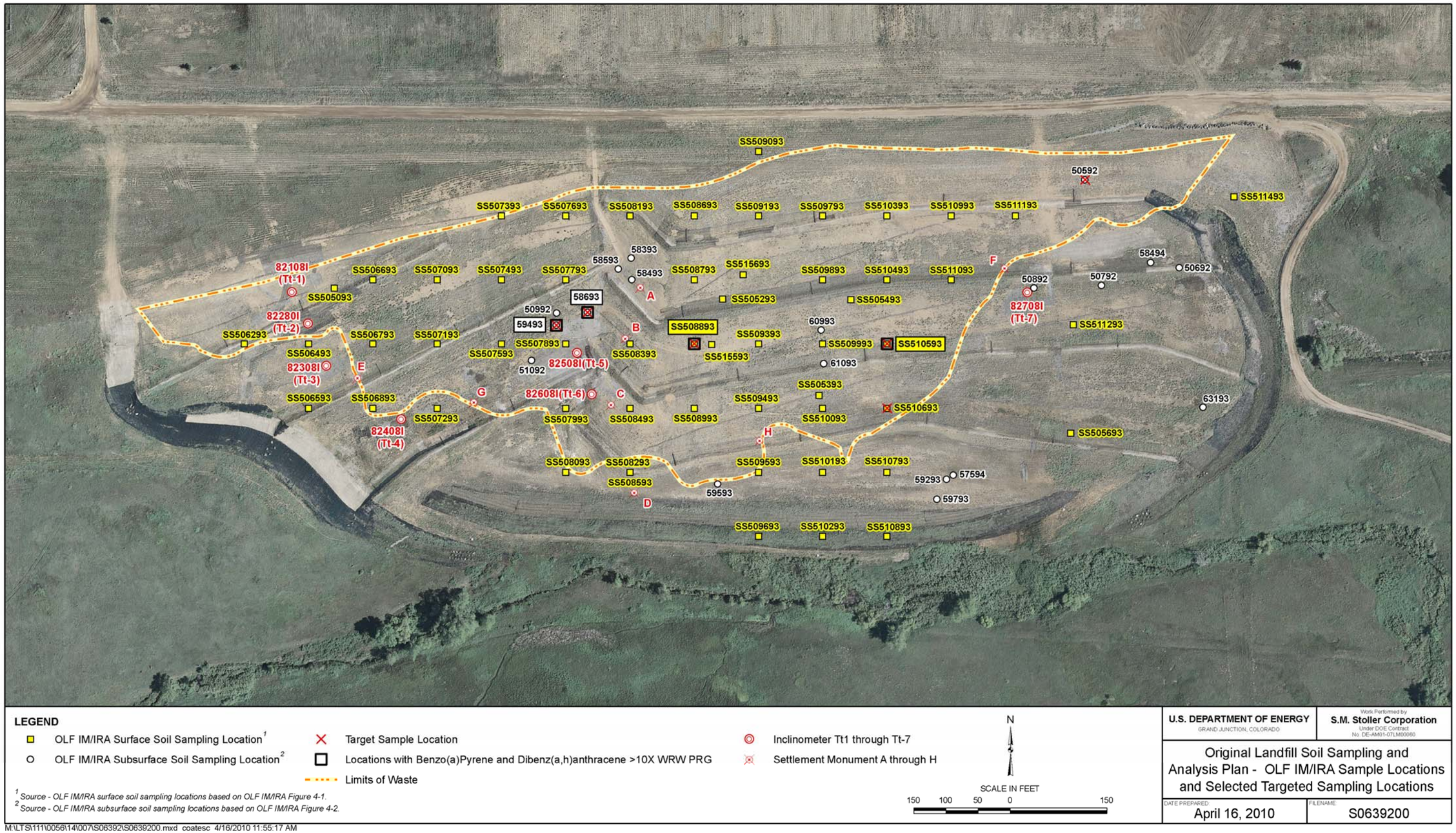

Figure 1. OLF IM/IRA Sample Locations and Selected Targeted Sampling Locations

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Table 1. Surface Soil Results
Yellow highlight shows analytes that have one or more results above WRW PRG or CDPHE screening value.
This table is derived from OLF IM/IRA Table 4−1. NOTE—uranium values are no longer representative—hot spots removed.

Analyte Group	Analyte	Total number of samples	Average Conc.	Maximum Conc.	BG Mean Plus 2SD	Wildlife Refuge Worker surface soil PRG	CDPHE Soil Evaluation Values (CSEV) or EPA PRG	Number of samples above WRW surface soil PRG	Number of samples above CSEV or EPA PRG
Metal (mg/kg)	Aluminum	51	10,257	20,000	16,902	24,774	75,000	0	0
	Antimony	44	9.05	49.8	0.47	44.4	31	1	2
	Barium	51	108	177	141	2,872	1,500	0	0
	Beryllium	51	0.87	1.7	0.966	100	150	0	0
	Cadmium	45	0.76	4.1	1.61	91.4	70	0	0
	Chromium (assume Cr III)	51	12.3	24.2	17	166,630	120,000	0	0
	Cobalt	51	8.1	13.6	10.9	122	700	0	0
	Copper	51	30.6	184	18.1	4,443	3,100	0	0
	Iron	51	13,518	20,600	18,037	33,326	23,000	0	0
	Lead	51	24.3	129	54.62	1,000	400	0	0
	Lithium	51	7.7	15.3	11.6	2,222	160	0	0
	Manganese	51	250.7	829	365	443	1,500	3	0
	Mercury	51	0.14	0.38	0.134	33	23	0	0
	Nickel	51	13.9	26.3	14.9	2,222	1,600	0	0
	Strontium	51	28.9	62.4	48.9	66,652	47,000	0	0
	Tin	51	6.6	30.9	2.9	66,652	none	0	n/a
	Zinc	51	59	199	73.8	33,326	23,000	0	0
PCB (µg/kg)	Aroclor-1254	51	801.4	9,200	n/a	1,349	220	6	41
Pesticide (µg/kg)	4,4'-DDT	51	54.9	920	n/a	10,927	1,700	0	0
	Dieldrin	51	56	920	n/a	187	40	2	11
	Endosulfan sulfate	51	55	920	n/a	480,861	Pending	0	n/a

Table 1 (continued). Surface Soil Results

Analyte Group	Analyte	Total number of samples	Average Conc.	Maximum Conc.	BG Mean Plus 2SD	Wildlife Refuge Worker surface soil PRG	CDPHE Soil Evaluation Values (CSEV) or EPA PRG	Number of samples above WRW surface soil PRG	Number of samples above CSEV or EPA PRG
Rad (pCi/g)	Americium-241	57	0.012	0.0865	0.0227	7.69	n/a	0	n/a
	Plutonium-239/240	58	0.043	0.338	0.066	9.78	n/a	0	n/a
	Uranium-234	59	55.2	2,800	2.25	25.3	n/a	3	n/a
	Uranium-235	59	12.9	670	0.0939	1.05	n/a	4	n/a
	Uranium-238	59	17.2	38,000	2	29.3	n/a	5	n/a
SVOC (µg/kg)	2-Methylnaphthalene	48	867	12,000	n/a	320,574	290,000	0	0
	Acenaphthene	49	1,479	44,000	n/a	4,437,768	1,000,000	0	0
	Anthracene	49	1,541	47,000	n/a	22,188,842	1,000,000	0	0
	Benzo(a)anthracene	54	1,601	45,000	n/a	3,793	220	2	36
	Benzo(a)pyrene	49	1,589	43,000	n/a	379	22	40	48
	Benzo(b)fluoranthene	39	1,824	49,000	n/a	3,793	220	2	34
	Benzo(k)fluoranthene	49	1,156	25,000	n/a	37,927	2,200	0	1
	Chrysene	48	1,648	46,000	n/a	379,269	22,000	0	0
	Dibenzo(a,h)anthracene	36	823	9,200	n/a	379	22	30	35
	Dibenzofuran	49	1,011	20,000	n/a	222,174	140,000	0	0
	Fluoranthene	49	3,901	140,000	n/a	2,958,512	1,000,000	0	0
	Fluorene	48	1,371	39,000	n/a	3,205,741	1,000,000	0	0
	Indeno(1,2,3-cd)pyrene	38	1,437	32,000	n/a	3,793	220	1	30
	Pyrene	49	3,361	120,000	n/a	2,218,884	1,000,000	0	0
VOC (µg/kg)	Naphthalene	49	1,486	41,000	n/a	1,403,301	1,000,000	0	0

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
n/a = not applicable

Table 2. Subsurface Soil Results
Yellow highlight shows analytes that have one or more results above WRW PRG or CDPHE screening value.
This table is derived from OLF IM/IRA Table 4−2.

Analyte Group	Analyte	Total number of samples	Average Conc.	Maximum Conc.	BG Mean Plus 2SD	Wildlife Refuge Worker Surface Soil PRG	CDPHE Soil Evaluation Values (CSEV) or EPA PRG	Number of samples above WRW surface soil PRG	Number of samples above CSEV or EPA PRG
Metal (mg/kg)	Antimony	51	10.8	19.5	0.47	44.4	31	0	0
	Arsenic	62	5.2	18.9	13.14	2.41	0.39	55	61
	Barium	62	111	387	289.38	2,872	1,500	0	0
	Cadmium	61	0.8	2.3	1.7	91.4	70	0	0
	Chromium (assume Cr III)	62	18.1	165	68.27	166,630	120,000	0	0
	Copper	62	152	6,920	38.21	4,443	3,100	1	1
	Iron	62	16,612	78,900	41,047	33,326	23,000	2	6
	Lead	62	32.9	304	24.97	1,000	400	0	0
	Manganese	62	258	1,540	902	443	1,500	5	1
	Molybdenum	60	5.5	190	25.61	555	390	0	0
	Nickel	62	23.3	118	62.21	2,222	1,600	0	0
	Silver	60	2.7	36	24.54	555	390	0	0
	Zinc	62	98.1	673	139.1	33,326	23,000	0	0
PCB (µg/kg)	Aroclor-1254	53	272.7	960	-	1,349	220	0	15
	Aroclor-1260	54	238.2	1,300	-	1,349	220	0	9
Rad (pCi/g)	Americium-241	60	0.019	0.46	0.02	7.69	n/a	0	n/a
	Plutonium-239/240	62	0.1	3.2	0.02	9.78	n/a	0	n/a
	Uranium-234	62	2.0	30	2.64	25.3	n/a	1	n/a
	Uranium-235	62	0.11	2.3	0.12	1.05	n/a	1	n/a
	Uranium-238	62	1.61	12	1.49	29.3	n/a	0	n/a

Table 2 (continued). Subsurface Soil Results

Analyte Group	Analyte	Total number of samples	Average Conc.	Maximum Conc.	BG Mean Plus 2SD	Wildlife Refuge Worker Surface Soil PRG	CDPHE Soil Evaluation Values (CSEV) or EPA PRG	Number of samples above WRW surface soil PRG	Number of samples above CSEV or EPA PRG
SVOC (µg/kg)	2-Methylnaphthalene	54	715	15,000	n/a	320,574	290,000	0	0
	Acenaphthene	54	1,020	31,000	n/a	4,437,768	1,000,000	0	0
	Anthracene	54	1,370	46,000	n/a	22,188,842	1,000,000	0	0
	Benzo(a)anthracene	54	1,499	48,000	n/a	3,793	220	2	50
	Benzo(a)pyrene	54	1,360	43,000	n/a	379	22	43	53
	Benzo(b)fluoranthene	54	1,532	48,000	n/a	3,793	220	2	52
	Benzo(k)fluoranthene	54	805	19,000	n/a	37,927	2,200	0	1
	Butylbenzylphthalate	54	1,230	38,000	n/a	16,028,707	1,000,000	0	0
	Chrysene	54	1,585	53,000	n/a	379,269	22,000	0	1
	Dibenz(a,h)anthracene	54	1,121	38,000	n/a	379	22	37	53
	Dibenzofuran	54	805	20,000	n/a	222,174	140,000	0	0
	Fluoranthene	54	3,944	160,000	n/a	2,958,512	1,000,000	0	0
	Fluorene	54	1,100	35,000	n/a	3,205,741	1,000,000	0	0
	Indeno(1,2,3-cd)pyrene	54	913	22,000	n/a	3,793	220	1	50
	Pyrene	54	3,634	150,000	n/a	2,218,884	1,000,000	0	0
VOC (µg/kg)	Acetone	126	42	280	n/a	99,978,261	1,000,000	0	0
	Chloroform	128	7.1	31	n/a	7,850	300	0	0
	Ethylbenzene	128	7.4	66	n/a	5,385,973	1,000,000	0	0
	Methylene Chloride	128	10.6	150	n/a	271,792	9,000	0	0
	Naphthalene	54	1,068	61,000	n/a	1,403,301	1,000,000	0	0
	Tetrachloroethene	128	33.2	900	n/a	6,705	450	0	2
	Toluene	126	16.7	220	n/a	3,094,217	1,000,000	0	0
	Trichloroethene	128	13.1	390	n/a	1,770	39	0	6
	Xylene	128	8.05	150	n/a	1,059,049	280,000	0	0

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram
n/a = not applicable

The average concentrations of all results were below the WRW PRGs, except for the SVOCs Benzo(a)pyrene and Dibenzo(a,h)anthracene. Figure 1 shows the locations where these analytes were measured at concentrations greater than ten times the WRW PRGs.

The CDPHE policy screening levels do not contain levels for radionuclides, but Table 1 and Table 2 include the radionuclide data from the OLF IM/IRA soils data summary tables for completeness. Confirmation sampling after the hot spot removal and prior to construction of the OLF soil cover showed that residual radionuclide concentrations were well below WRW PRGs and were essentially at background.

The proposal to perform the OLF soils sampling work was approved by CDPHE as documented in Rocky Flats Legacy Management Agreement (RFLMA) Contact Record (CR) 2010-01. In accordance with CR 2010-01, this SAP is subject to review and approval by CDPHE prior to beginning sampling work.

3.0 Data Quality Objectives

The data quality objective process states the problem and identifies the project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. This information is used to help optimize the sampling design.

The problem is to determine if the OLF residual soil contamination levels at the OLF allow termination of post-closure care in accordance with CDPHE evaluation criteria.

The project decisions are to determine the following:

- Whether sampling and analysis results show analyte concentrations above soil contamination screening levels specified by the CDPHE policy and WRW PRGs that is similar to the OLF IM/IRA data set;
- Whether residual contamination levels are stable or may have decreased; and
- Analyte concentrations to evaluate risk from exposure to residual soil contamination if the subsurface soils became exposed to the surface.

The inputs to the decisions will include the following:

- Comparison of sampling and analysis results to the existing OLF IM/IRA data by targeted sampling of specified OLF IM/IRA sampling locations;
- Use of sampling and analysis results for evaluation of human health risk based on the exposure parameters and pathways used to develop the WRW PRGs; and
- Providing additional sampling and analysis results to reduce potential spatial gaps in the OLF IM/IRA data.

The study boundaries are soils between the bottom of the 2-foot-thick clean soil cover and the vicinity of the top of the underlying bedrock (approximately a 30-foot-thick layer), and within the footprint of the OLF waste disposal area. Because soils below about 25 feet are unlikely to become exposed to the surface, unless heavy excavation means are employed, the boundary will

be a 25-foot depth below the 2-foot soil cover. As discussed in the sampling methodology section below, this enables using 5-foot core sections as the approximate starting and ending depths for each sample. Samples will be collected in the 5-foot cores to the extent practical, and it is recognized some cores may not be full of sample when removed from the borehole.

The following decision rules support the sampling design:

- Sampling locations should target locations where existing OLF IM/IRA data indicated maximum levels of contamination so that the magnitude of changes, if any, may be estimated;
- Appropriate additional sampling locations identified to provide more spatially representative data for risk evaluation; and
- Analytes should be consistent with analytes in the existing OLF IM/IRA soil sample data reflected in Table 1 and Table 2.

The sampling design is based on minimizing field sampling and analytical costs for this preliminary characterization effort to gather a reasonable amount of data for further evaluation for post-closure care decision making. This will help to inform RFLMA consultation and to determine what, if any, additional data may be needed.

Sample analysis will be performed using EPA Contract Laboratory Program (CLP) procedures. The CLP procedures were selected because these are the procedures that were used to generate the existing OLF IM/IRA data. This will allow comparison to historical data without introducing additional uncertainties due to differences in analytical procedures.

4.0 Site Description

The OLF presents features that will affect ingress, egress, set up, and sampling using the track-mounted Geoprobe unit at the designated sampling locations. These features are described below, along with a general description of the OLF.

The OLF is approximately 20 acres in area and is located north of Woman Creek and south of the gravel access road leading into the RFS from the west. The OLF surface features include seven approximately 2- to 3-foot-high diversion berms that direct precipitation run off into approximately 5-foot-deep perimeter drainage channels at the east and west edges of the soil cover. The OLF cover slopes up to 18 percent from the north to the south; a buttress along the southern toe of the cover has a steeper slope along its south side, which ends at an elevation that is approximately equivalent to that of Woman Creek.

Features also include seven inclinometers and nine settlement monuments, with vertical casings on the surface. Three downgradient monitoring wells with vertical casings are located south of the bottom of the buttress. Several seeps occasionally have surface expressions, and the surface areas around the seeps may be saturated even when the seeps are not expressing. Several geotextiles-wrapped crushed rock subsurface seep drains and a buttress drain are located under the surface of the cover.

5.0 Previous Post-Closure Soil Sampling and Other Intrusive Work

The experience gained in completing recent (i.e., post-closure) subsurface geotechnical soil investigations and construction work to regrade the west perimeter channel and install/extend seep drains was considered in developing this SAP. This experience indicates that sampling with a track-mounted Geoprobe and work involving soil sampling and handling IDM can be done safely at the OLF. The recent work includes:

1. Drilling seven 6-inch-diameter boreholes to collect continuous core samples from the surface to bedrock (25 to 35 feet below the surface) and installing inclinometers to support geotechnical objectives;
2. Excavating eight trenches approximately 4-feet wide by 20-feet long by 12-feet deep and one smaller, shallower trench, to allow a geologist to perform visual examination, cross-section logging, and soil sample collection, also to support geotechnical objectives;
3. Constructing a 6-inch-thick crushed rock seep drain extension approximately 60-feet long by 30-feet wide 2-feet below the surface, with an approximately 20-foot-long tie in to the existing drain about 5-feet below the surface; and
4. Excavating and installing tie ins for several crushed rock drains into a drain in the west perimeter channel during regrading and filling portions of the west perimeter channel to improve the stability of the OLF cover adjacent to the channel.

During the geotechnical investigation work in items 1 and 2 above, industrial hygiene and radiological field monitoring was performed and no health and safety issues were found. The work described above is discussed in more detail in the RFLMA Annual Report of Site Surveillance and Monitoring for 2008 and 2009 (DOE 2009, 2010).

In addition, while there are intermittent seeps at the OLF, groundwater in amounts sufficient to create a sample collection or handling issue was not encountered during the geotechnical investigation borehole drilling.

6.0 Soil Sampling Locations

The selected sampling locations are shown in Figure 2. Samples will be collected at or in close proximity to the selected locations, depending upon field conditions. The identified locations will be surveyed and marked prior to the sampling work.

Locations were selected to avoid interference with OLF components such as inclinometers. If conditions are encountered in the field that may pose a problem because of surface conditions or infrastructure, locations will be moved to avoid the problem. For example, if a location is in an area saturated by seep water, the ground may not be suitable for stabilizing the Geoprobe during drilling. Also, the locations were selected to avoid the footprint of the diversion berms, as it will be more productive to sample away from the berms, rather than excavate and rebuild them. In addition, because of the cobbly nature of the soils, and the presence of waste debris mingled with the soils, refusal of the sampling tools may be encountered at depth.

Upon refusal at any depth within the sampling interval, the field crew will offset 1 to 3 feet from the initial location and attempt to collect the samples from the depth intervals not sampled. No more than three attempts to collect the samples upon refusal will be made. If the surveyed locations are not the sampled locations, the actual sample locations on the surface of the OLF cover will be documented by the field crew by measuring the distance in feet 90 degrees north or south, and east or west from the surveyed location, and the difference in elevation. The sample location will then be marked after completion of sampling for subsequent survey of the location. The reason for moving the location shall also be documented.

6.1 Targeted Locations

Six targeted sampling locations were selected for sampling. The rationale for the selected targeted sampling locations is presented below. Three locations were selected from the OLF IM/IRA surface soil data set and three were selected from the subsurface soil data set. The targeted locations that are associated with OLF IM/IRA surface soil locations will be sampled to the full depth described in this SAP.

The rationale for the selected targeted sampling locations is as follows:

SS510593—This surface soil location produced samples having the maximum concentrations of 2-Methylnapthalene, Aroclor-1254, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dieldrin, Dibenzo(a,h)anthracene and Indeno(1,2,3-cd)pyrene. This location had Benzo(a)pyrene and Dibenzo(a,h)anthracene concentrations greater than ten times the WRW PRG.

SS510693—This surface soil location is directly south of SS510693 and produced samples with a relatively high concentration of Aroclor-1254.

SS508893—Samples from this surface soil location had the second highest concentrations of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, and Dibenzo(a,h)anthracene. This location had Benzo(a)pyrene concentration greater than ten times the WRW PRG.

58693—This subsurface location is in the area of the former IHSS 196, Filter Backwash Pond located within the OLF footprint. It produced samples with the maximum concentrations of Aroclor-1254, Arsenic, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Dieldrin, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene, and iron. It is located about 500 feet west of SS510693 (described above). This location is also in the vicinity of a seep known as seep 7, which has a surface expression at intervals after heavy precipitation events. This location had Benzo(a)pyrene and Dibenzo(a,h)anthracene concentrations greater than ten times the WRW PRG.

50592—This subsurface location is on the northern edge of the waste footprint and produced samples with levels of Aroclor-1254 and -1260 slightly above the WRW PRG and the maximum concentration of manganese.

59493—This subsurface location also had elevated levels of Aroclor-1254, Arsenic, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenzo(a,h)anthracene, Indeno(1,2,3-cd)pyrene and copper. This location had Benzo(a)pyrene concentrations greater than ten times the WRW PRG.

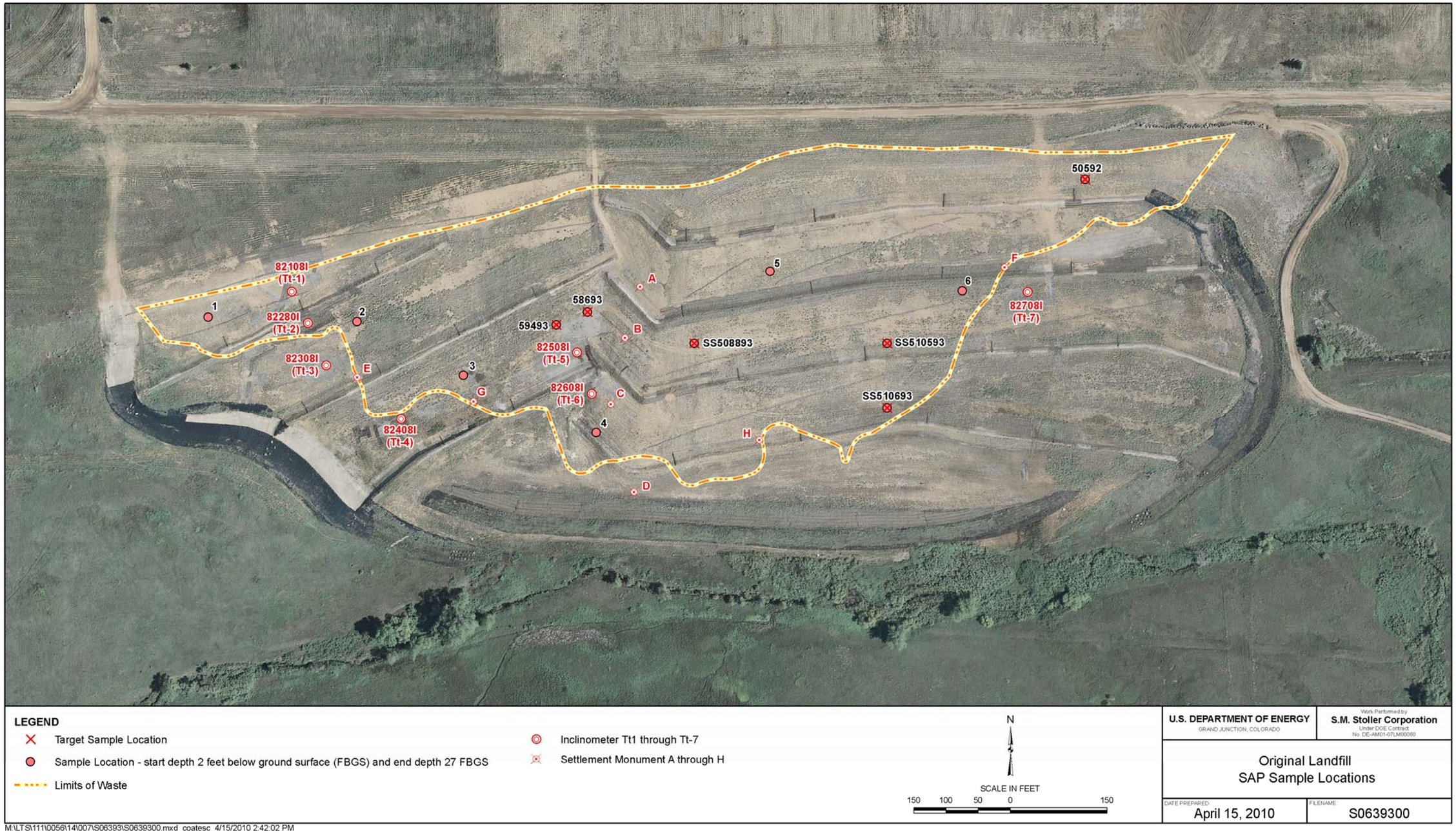

Figure 2. Subsurface Soil Sampling Locations

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The results from these locations will be useful in comparison of elevated levels of SVOCs and PCBs in the OLF IM/IRA data to current levels to evaluate the potential magnitude of natural attenuation over time, if any.

6.2 Additional Locations

The additional locations were selected to provide additional subsurface data from the east and west side of the OLF. The west side of the OLF has experienced localized movement resulting in surface cracking and slumping and additional subsurface data can help evaluate the level of risks from exposure to subsurface soils that might become exposed if the movement became significant.

7.0 Sampling and Analytical Requirements

7.1 Soil Sampling

Because the OLF is covered with at least 2 feet of clean native soils, the top 2 feet of material will not be sampled. Instead, the clean cover soil will be removed by the Geoprobe and set aside. The Geoprobe will then be used to collect soil cores of the subsurface soils, which will be sampled for laboratory analysis.

The following information will be recorded during the collection of each sample:

- Sample location, depth interval and description
- Amount of sample collected in the core
- Date and time of each sample collection
- Designation of sample as composite or grab
- Field instrument readings
- Field observations and details related to analysis or integrity of samples (e.g., weather conditions, noticeable odors, colors)
- Preliminary sample descriptions

7.1.1 Coring and Describing Subsurface Soils

Five-foot-long cores will be collected in sleeves using the Geoprobe direct-push method. Samples will be collected in the 5-foot core sleeve to the extent practical, and it is recognized some core sleeves may not be full of sample when removed from the borehole. Cores will be carefully and promptly removed from the sleeve and sampled for laboratory analysis. Each sampling location will be sampled from the initial depth (described above) to 25 feet below that depth. Each core retrieved over that entire depth interval will be sampled for volatile organic compounds (VOCs) and other analytes, as described below.

While analytical samples are the primary objective of this sampling effort, it will also be necessary to document the general characteristics of the cores being generated. Therefore, the core will be described at the same time the core is being processed for samples. Observing core characteristics will not be allowed to cause delay in containerizing core for VOC samples. To

improve sample integrity, it may be necessary to forego complete description of the core in the intervals removed for VOC samples.

7.1.2 Volatiles Grab Samples

One discrete sample for VOC analysis will be collected to characterize each core interval immediately upon removing the core from the sleeve. The sample will be selected from the deepest section of recovered core (i.e., closest to the downhole tip of the core barrel). This location is typically least disrupted by the hammering action of the Geoprobe, while shallower portions of the core may be significantly affected (e.g., expanded, heated, or aired out by the strong vibrations). Material will be used to fill sample containers as full as possible, thereby minimizing headspace in the containers. This entire process will be completed as quickly and efficiently as possible to minimize offgassing of VOCs that may be present. Soil handling associated with collection of VOC samples will be conducted in a shaded area (behind Geoprobe, under table, etc.) so as to reduce the effects of sunlight-related degradation of residual VOCs.

7.1.3 Composite Sampling

After the volatile samples for a given core interval have been properly collected and stored, the remaining core from that interval will be placed in a stainless-steel pan or bowl. The sample will be mixed until a relatively consistent color and texture is achieved. Portions of each composite sample will be placed in appropriate containers for laboratory analysis.

7.2 Sample Handling, Documentation, and Custody

Samples will be collected and containerized in the order of decreasing volatility of analytes. The collection order is:

1. Volatiles
2. Semivolatiles
3. Pesticides and PCBs
4. Metals and radiochemical analytes

A sufficient sample volume will be collected from each location to serve the needs of all analyses, including field and laboratory quality control.

Field documentation will be kept in accordance with the standard practice requirements for documenting activities related to field sampling and measurement in the *Sampling and Analysis Plan for U.S. Department of Energy Office of Legacy Management Sites* (LMS/PLN/S04351). Sample documentation includes sample designation, sample logs, sample labeling, field notes, and chain of custody (COC) forms. Sample designation provides that each sample will be uniquely identified, labeled, and documented in the field at the time of collection. Each sample container will be labeled listing the sample ticket number, sample location, date and time of collection, requested analysis, and requisition index number.

As noted above, the primary objective is collection of analytical samples. However, fundamental information on core characteristics may prove valuable in interpreting the analytical results.

Therefore, soil cores will be described in general terms (fundamental soil type and corresponding approximate USCS classification, coloration, relative moisture, and any distinguishing characteristics) on the appropriate logging form. Recording details such as Munsell colors, exact grain size distributions that would be expected from sieve analyses, plasticity, etc. are not required.

Sample container, holding time, and preservation requirements are listed in Table 3.

Table 3. Sample Containers, Holding Times, and Preservation

Analytes	Container	Preservation	Holding Time
Metals and Radiochemistry	125 mL wide-mouthed Poly	None	6 months
Pesticides and PCBs	250 mL wide-mouthed Glass	Cool, 4 °C	7 days
Semivolatiles	250 mL wide-mouthed Glass	Cool, 4 °C	7 days
Volatiles	125 mL wide-mouthed Glass	Cool, 4 °C	14 days

Once collected, each sample container will be labeled and placed into a sample cooler and chilled to 4 °C to preserve the samples. The samples will be shipped to the laboratory promptly in order to provide adequate time for analyses within the established holding times. Prior to shipment, the sample bottles will be packed with shock-absorbent materials such as bubble wrap to prevent breakage during shipment.

Each sample shipment will be accompanied by a COC form listing the sample containers included in the shipment. The information on the COC form will include:

- Requisition index number
- Sample ticket number
- Date and time sampled
- Location ID
- Number of containers and description
- Requested analysis
- Signature, date, and time of relinquishment of the shipment

7.3 Decontamination and Investigation-Derived Material Disposition

A piece of heavy duty plastic sheet will be placed over the area around the sample location to catch any subsurface soils that may fall from the samples/sampling equipment. The soils will be kept away from the hole until sampling is completed, and then will be returned to hole.

The downhole Geoprobe equipment will be decontaminated with an appropriate aqueous based solution between each location, and the decontamination material collected in a suitable container. The Geoprobe equipment will also be dry wiped or brushed as needed to remove visible soils between samples. Decontamination material will be collected and returned to the borehole after completion of sampling, to extent possible, and the material tamped down to below the 2-foot soil cover layer. Sand, fine gravel, or other suitable fill material will be used to

fill the bore holes. A manually excavated hole that extends to below the soil cover may be used for disposition of the IDM that cannot be returned to the borehole. Removed materials, wipes, and waste decontamination solution will be placed in the hole before backfilling the hole, and the location will be documented for reporting.

Disposable personnel protective equipment (PPE), such as gloves and Tyvek outerwear, shall be placed in plastic bags for storage in the east shed pending the results of the soils analysis. Any visible chunks of soil and debris attached to PPE should be removed from the PPE for disposition as IDM before placing in bags. The soil analytical data will be used to determine proper disposition of the PPE and similar disposables. Since the OLF is not a hazardous waste landfill, and low concentrations of PCBs and other characteristic hazardous waste constituents are expected, it is assumed the PPE can be disposed as solid non-hazardous waste.

7.4 Analytical Requirements

The analytical procedures selected are based on EPA CLP procedures, where applicable. The CLP procedures were selected because these are the procedures that were used to analyze the samples collected in 1993. The analytical methods, analytes, and required detection limits are listed in Table 4.

Table 4. Analytes, Methods, and Required Detection Limits

Analyte Group	Analyte	Method	RDL
Metal (mg/kg)	Aluminum	CLP SOW	3
	Antimony	CLP SOW	1
	Arsenic	CLP SOW	0.7
	Barium	CLP SOW	20
	Beryllium	CLP SOW	0.2
	Cadmium	CLP SOW	0.1
	Calcium	CLP SOW	1000
	Chromium	CLP SOW	0.4
	Cobalt	CLP SOW	10
	Copper	CLP SOW	0.6
	Iron	CLP SOW	20
	Lead	CLP SOW	0.4
	Lithium	CLP SOW	20
	Magnesium	CLP SOW	1000
	Manganese	CLP SOW	3
	Mercury	CLP SOW	0.2
	Molybdenum	CLP SOW	6
	Nickel	CLP SOW	5
	Potassium	CLP SOW	1000
	Selenium	CLP SOW	2
	Silver	CLP SOW	0.5
	Sodium	CLP SOW	1000
	Strontium	CLP SOW	40
	Thallium	CLP SOW	2
	Tin	CLP SOW	40
	Uranium	CLP SOW	40

Table 4 (continued). Analytes, Methods, and Required Detection Limits

Analyte Group	Analyte	Method	RDL
Metal (mg/kg)	Vanadium	CLP SOW	8
	Zinc	CLP SOW	4
Pesticide/PCB (µg/kg)	alpha-BHC	CLP SOW	1.7
	beta-BHC	CLP SOW	1.7
	delta-BHC	CLP SOW	1.7
	gamma-BHC (Lindane)	CLP SOW	1.7
	Heptachlor	CLP SOW	1.7
	Aldrin	CLP SOW	1.7
	Heptachlor epoxide	CLP SOW	1.7
	Endosulfan I	CLP SOW	1.7
	Dieldrin	CLP SOW	3.3
	4,4'-DDE	CLP SOW	3.3
	Endrin	CLP SOW	3.3
	Endosulfan II	CLP SOW	3.3
	4,4'-DDD	CLP SOW	3.3
	Endosulfan sulfate	CLP SOW	3.3
	4,4'-DDT	CLP SOW	3.3
	Methoxychlor	CLP SOW	17
	Endrin ketone	CLP SOW	3.3
	Endrin aldehyde	CLP SOW	3.3
	alpha-Chlordane	CLP SOW	1.7
	gamma-Chlordane	CLP SOW	1.7
	Toxaphene	CLP SOW	170
	Aroclor-1016	CLP SOW	33
	Aroclor-1221	CLP SOW	67
	Aroclor-1232	CLP SOW	33
	Aroclor-1242	CLP SOW	33
	Aroclor-1248	CLP SOW	33
	Aroclor-1254	CLP SOW	33
	Aroclor-1260	CLP SOW	33
Radiochemical (pCi/g)	Americium-241	Alpha Spectrometry	0.3
	Plutonium-239/240	Alpha Spectrometry	0.3
	Uranium-234	Alpha Spectrometry	1
	Uranium-235	Alpha Spectrometry	1
	Uranium-238	Alpha Spectrometry	1
Semivolatile (µg/kg)	1,2,4-Trichlorobenzene	CLP SOW	330
	1,2-Dichlorobenzene	CLP SOW	330
	1,3-Dichlorobenzene	CLP SOW	330
	1,4-Dichlorobenzene	CLP SOW	330
	2,2'-oxybis(1-Chloropropane)	CLP SOW	330
	2,4,5-Trichlorophenol	CLP SOW	1600
	2,4,6-Trichlorophenol	CLP SOW	330
	2,4-Dichlorophenol	CLP SOW	330
	2,4-Dimethylphenol	CLP SOW	330
	2,4-Dinitrophenol	CLP SOW	1600
	2,4-Dinitrotoluene	CLP SOW	330
	2,6-Dinitrotoluene	CLP SOW	330

Table 4 (continued). Analytes, Methods, and Required Detection Limits

Analyte Group	Analyte	Method	RDL
Semivolatile (µg/kg)	2-Chloronaphthalene	CLP SOW	330
	2-Chlorophenol	CLP SOW	330
	2-Methylnaphthalene	CLP SOW	330
	2-Methylphenol	CLP SOW	330
	2-Nitroaniline	CLP SOW	1600
	2-Nitrophenol	CLP SOW	330
	3,3'-Dichlorobenzidine	CLP SOW	330
	3-Nitroaniline	CLP SOW	1600
	4,6-Dinitro-2-methylphenol	CLP SOW	1600
	4-Bromophenyl-phenylether	CLP SOW	330
	4-Chloro-3-methylphenol	CLP SOW	330
	4-Chloroaniline	CLP SOW	330
	4-Chlorophenyl-phenyl ether	CLP SOW	330
	4-Methylphenol	CLP SOW	330
	4-Nitroaniline	CLP SOW	1600
	4-Nitrophenol	CLP SOW	1600
	Acenaphthene	CLP SOW	330
	Acenaphthylene	CLP SOW	330
	Anthracene	CLP SOW	330
	Benzo(a)anthracene	CLP SOW	330
	Benzo(a)pyrene	CLP SOW	330
	Benzo(b)fluoranthene	CLP SOW	330
	Benzo(g,h,i)perylene	CLP SOW	330
	Benzo(k)fluoranthene	CLP SOW	330
	bis(2-Chloroethoxy) methane	CLP SOW	330
	bis(2-Chloroethyl) ether	CLP SOW	330
	bis(2-ethylhexyl)phthalate	CLP SOW	330
	Butylbenzylphthalate	CLP SOW	330
	Carbazole	CLP SOW	330
	Chrysene	CLP SOW	330
	Dibenz(a,h)anthracene	CLP SOW	330
	Dibenzofuran	CLP SOW	330
	Diethylphthalate	CLP SOW	330
	Dimethylphthalate	CLP SOW	330
	Di-n-butylphthalate	CLP SOW	330
	Di-n-octylphthalate	CLP SOW	330
	Fluoranthene	CLP SOW	330
	Fluorene	CLP SOW	330
	Hexachlorobenzene	CLP SOW	330
	Hexachlorobutadiene	CLP SOW	330
	Hexachlorocyclopentadiene	CLP SOW	330
	Hexachloroethane	CLP SOW	330
	Indeno(1,2,3-cd)pyrene	CLP SOW	330
	Isophorone	CLP SOW	330
	Naphthalene	CLP SOW	330
	Nitrobenzene	CLP SOW	330
	N-Nitroso-di-n-propylamine	CLP SOW	330

Table 4 (continued). Analytes, Methods, and Required Detection Limits

Analyte Group	Analyte	Method	RDL
Semivolatile (µg/kg)	N-nitrosodiphenylamine	CLP SOW	330
	Pentachlorophenol	CLP SOW	1600
	Phenanthrene	CLP SOW	330
	Phenol	CLP SOW	330
	Pyrene	CLP SOW	330
Volatile (µg/kg)	Chloromethane	CLP SOW	10
	Bromomethane	CLP SOW	10
	Vinyl Chloride	CLP SOW	10
	Chloroethane	CLP SOW	10
	Methylene Chloride	CLP SOW	10
	Acetone	CLP SOW	10
	Carbon Disulfide	CLP SOW	10
	1,1-Dichloroethene	CLP SOW	10
	1,1-Dichloroethane	CLP SOW	10
	1,2-Dichloroethene (total)	CLP SOW	10
	Chloroform	CLP SOW	10
	1,2-Dichloroethane	CLP SOW	10
	2-Butanone	CLP SOW	10
	1,1,1-Trichloroethane	CLP SOW	10
	Carbon Tetrachloride	CLP SOW	10
	Bromodichloromethane	CLP SOW	10
	1,2-Dichloropropane	CLP SOW	10
	cis-1,3-Dichloropropene	CLP SOW	10
	Trichloroethene	CLP SOW	10
	Dibromochloromethane	CLP SOW	10
	1,1,2-Trichloroethane	CLP SOW	10
	Benzene	CLP SOW	10
	trans-1,3-Dichloropropene	CLP SOW	10
	Bromoform	CLP SOW	10
	4-Methyl-2-pentanone	CLP SOW	10
	2-Hexanone	CLP SOW	10
	Tetrachloroethene	CLP SOW	10
	Toluene	CLP SOW	10
	1,1,2,2-Tetrachloroethane	CLP SOW	10
	Chlorobenzene	CLP SOW	10
	Ethyl Benzene	CLP SOW	10
	Styrene	CLP SOW	10
	Xylenes (Total)	CLP SOW	10

mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram

Factors that influence detection limits include the analytical method and instrument, sample matrix interference, and high concentration of target analytes. The required detection limits in Table 4 are the maximum values specified by contract. The actual method detection limits will vary from sample to sample in accordance with standard laboratory practices.

7.5 Quality Assurance

The *Quality Assurance Manual* (LMS/POL/S04320) specifies quality assurance requirements used to implement all environmental sampling and monitoring programs.

Additional quality assurance requirements and guidance for LM Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (i.e., Monticello, Fernald, Mound, and Rocky Flats) are provided in the *Legacy Management CERCLA Sites Quality Assurance Project Plan* (LMS/PLN/S04353).

Field quality control (QC) samples will be collected and analyzed to determine the effect of field activities on the accuracy and precision of the analytical data. The collection frequency for each field QC sample type is listed in Table 5. Field QC samples will be submitted along with the other samples to the laboratory under a fictitious location identifier.

Table 5. Field QC Samples

QC Sample type	Collection Frequency
Field Duplicate	One duplicate sample per 20 field samples
Equipment Blank[a]	One per day
Trip Blank	One per sample shipment

[a]Collected to verify decontamination

Field duplicate samples are collected and analyzed as an indication of overall precision of the measurement process. The precision observed includes both field and laboratory precision and has more variability than laboratory duplicates, which measure only laboratory performance. Field duplicates will be collected at a rate of one duplicate per 20 samples collected. Field duplicates will be analyzed for all analytes.

Equipment blanks are prepared and analyzed to document contamination attributable to the sample collection process. Equipment blanks will be prepared from analyte-free water used as a final rinse when decontaminating sampling equipment prior to the collection of the next sample. Equipment blanks will be collected at a rate of one day and analyzed for volatiles only.

Trip blanks are prepared and analyzed to document the contamination attributable to shipping and field-handling procedures. A trip blank will accompany each sample shipment of samples submitted for volatiles analysis. The trip blank will be analyzed for volatiles only.

7.6 Data Reporting and Validation

Laboratory data will be requested at Analytical Service Level D, Standard Plus Raw Data Deliverable. An ASL D deliverable includes a case narrative, COC documentation, sample results, CLP forms or their equivalent, plus all raw data and spectra generated in the acquisition of the sample data. This is to include, but not be limited to, QC sample data; analyses performed but not used for reporting; and all preparation, chemistry, counting, and instrument data generated during sample analysis.

Laboratory data will be validated in accordance with the *Environmental Procedures Catalog*, (LMS/PRO/S04325) "Standard Practice for Validation of Laboratory Data."

The purpose of this validation is to determine if data meet the specific technical and QC criteria established in the applicable Statement of Work and to establish the usability and extent of bias of any data not meeting those criteria through the evaluation of an analytical data package.

The following are reviewed during data validation:

- COC form and receipt documentation
- Case narrative
- Completeness of the analytical data
- Compliance with holding times
- Surrogate recoveries (organics)
- Internal standards recoveries
- Chemical recoveries (radiochemistry)
- Laboratory blank data
- Matrix spike performance
- Laboratory control sample (LCS) performance
- Duplicate sample performance
- Initial calibration
- Continuing calibration
- Target compound identification

A data validation report will be prepared describing the data review and validation and documenting, on the basis of methodology, the QC elements examined. The report shall include a summary of samples and qualifiers applied to the data as a result of the validation process and the supporting validation worksheets. The validation worksheets summarize the QC performance that is the basis for data qualification. Criteria that are documented on the worksheets include holding time/preservation compliance; calibration performance and serial dilution performance; laboratory, field, equipment, and trip blanks; surrogate, internal standard, matrix spike/matrix spike duplicate, and LCS recoveries; and replicate relative percent differences.

8.0 Field Project Organization

Responsibility for the field work is as follows:

- Stoller Project Lead—Direct and coordinate the planning and approval of work control and execution documents and control the scheduling of work. Conduct work readiness reviews with assistance from other team members. Coordinate the purchase of necessary supplies and consumables. Coordinate certification for shipping if samples are regulated under hazardous materials shipping requirements. Based on the review of existing data, a certified shipper is not anticipated to be needed.
- Stoller Field Operations Lead—Direct and coordinate the sampling work. Ensure any required erosion controls are in place and any work to maintain safe and stable conditions is done. Perform or assist in worker training duties as assigned. Conduct Job Safety Analysis (JSA) review with team members and assist with field modification of JSA as required. Perform Site Safety Supervisor oversight if Health and Safety (H&S) Specialist or Radiological Control Technician (RCT) is not present.
- Stoller H&S Specialist/RCT—Coordinate and perform the H&S/radiation control requirements, including monitoring, for safe conduct of the work. Perform or assist in worker training duties as assigned. Ensure workers have completed specified training. Prepare a Radiological Work Permit (RWP) form (LMS 1588e), if and when required. Establish PPE requirements. Conduct JSA and RWP review with team members and assist with field modification of JSA as required. Perform and/or direct radiological monitoring.
- Stoller Certified Industrial Hygienist (CIH)—Establish industrial hygiene (IH) monitoring requirements in coordination with H&S/RCT. Assist in training as assigned. Perform and/or direct IH monitoring.
- Stoller H&S Specialist—Coordinate with team members to prepare JSA. Assist the H&S/RCT and CIH with tasks, including radiological and/or IH monitoring under supervision and direction of H&S/RCT and CIH as needed.
- Stoller Geoprobe Operators—Mobilize, demobilize, operate, and maintain Geoprobe equipment. Perform sampling work. Decontaminate equipment as required.
- Stoller Sample Preparation and Shipment Coordinator - Rocky Flats Field Operations Technician—Coordinate with Geoprobe operators to collect and prepare samples for delivery to off-site laboratory.
- Stoller Ecologist—Coordinate with Field Supervisor for equipment ingress and egress, erosion controls, locations for equipment setup, and demobilization and revegetation.
- Stoller Field Operations Technicians—Assist Field Operations Lead in coordinating work, conducting inspections and repairs, assisting with setup of erosion controls, and performing revegetation activities.

The project team will also assist with preparation and review of the Project/Activity Evaluation form (LMS 1005e).

9.0 Health and Safety Information

The work involves collection of soil samples from boreholes and sample preparation and shipment for off-site analysis. The soils contain contaminated soils/commingled wastes that may be present at concentrations that could result in worker and/or environmental exposure to hazardous substances.

Equipment and vehicles used for the work include a track-mounted Geoprobe drill rig, ATV, and pickup trucks. Equipment will be operated in a manner that minimizes the hazards inherent with its use. A JSA will be prepared to cover the work in accordance with the *Health and Safety Manual* (LMS/POL/S04321).

Requirements in several applicable S.M. Stoller Corporation (Stoller) policy and procedure manuals apply to this work. The H&S information in this SAP addresses requirements in accordance with the following manuals:

- *Health and Safety Manual* (LMS/POL/S04321)
- *Radiological Control Manual* (LMS/POL/S04322)
- *Comprehensive Emergency Management System* (LMS/POL/S04326)
- *Integrated Safety Management System Description with Embedded Work Safety and Health Program* (LMS/POL/S04328)
- *Environmental Protection Manual* (LMS/POL/S04329)
- *Drilling Health and Safety Requirements* (LMS/POL/S04331)

Also, to supplement the JSA, the *Health and Safety Procedures Manual* (LMS/PRO/S04337) provides more detailed information on accomplishing tasks addressed in this SAP, such as decontamination and monitoring.

9.1 Levels of Contamination

This work is expected to pose a low risk of exposure, based on OLF IM/IRA data presented in Table 1 and Table 2, previous intrusive work and the *Rocky Flats Site Comprehensive Risk Assessment* (CRA) (DOE 2006). The only significant exposure pathway for the work is from inhalation of low levels of airborne contamination from soil particles or VOCs generated from excavation and Geoprobe sampling and from incidental ingestion of soil particles that may contaminate a worker's skin or clothing. Air monitoring for radionuclides was conducted during the beginning of the cut-and-fill operation of the OLF closure in 2005, and this monitoring confirmed that concentrations were below levels requiring respiratory protection. Given that the activities described herein will result in less disruption than did closure of the OLF, the levels of airborne radionuclides should be negligible.

The contamination controls, including appropriate levels of PPE, monitoring, and other requirements outlined in this section serve to minimize exposure. The JSA and RWP provide the specific monitoring requirements and plans.

The OLF IM/IRA soil data were reviewed to assess H&S requirements, given that even if they are no longer representative, they are the best available. This review indicates that concentrations of the following analytes may have maximum, and in some cases also average, concentrations that are above the CDPHE residential/unrestricted use soil screening levels (without subtracting natural background, where a background value exists):

- Antimony
- Arsenic
- Copper
- Iron
- Manganese
- PCB Aroclor 1254 and 1260
- Dieldrin
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenzo(a,h)anthracene
- Dibenzofuran
- Indeno(1,2,3-cd)pyrene
- Tetrachloroethene
- Trichloroethene

Except for arsenic, the metals concentration data above the CDPHE residential/unrestricted use soil screening levels are from less than 10 percent of the samples in Table 1 and Table 2. Arsenic data are consistent with overall Rocky Flats soil data for arsenic, reflecting the ubiquitous typical natural soil arsenic levels.

VOC concentration data above the CDPHE screening levels are from less than 5 percent of the samples in Table 1 and Table 2.

The PCB, pesticide, and SVOC data show higher percentages of data in Table 1 and Table 2 exceeding the CDPHE residential/unrestricted use soil screening levels, with nearly all sample results for the SVOCs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene exceeding the CDPHE screening levels. It is believed that the SVOC constituents are related to incomplete combustion of fossil fuels from motor vehicle use and are present in the OLF from road and parking lot construction, maintenance waste, and run off of precipitation from adjacent or nearby roads and parking lots. The PCBs are probably related to wastes from cleanup of transformer oils containing PCBs and carbonless copy paper. Pesticides were used at Rocky Flats for their intended purpose, with some wastes probably going to the OLF.

9.2 Exposure and Contamination Controls Approach

The extent of contamination controls shall be determined based on monitoring of the borehole and recovered sample cores as the work progresses. The soil cover is clean material and has a minimum thickness of 2 feet but is nominally about 3-feet thick. The top 2 feet will be excavated and stockpiled separately from underlying materials.

The potential for exposure to depleted uranium as a localized contaminant in the OLF is not likely to result in a total effective dose equivalent to any workers above levels that would require personnel monitoring, based on the CRA. However, depleted uranium could present a potential for worker contamination, as well as contamination on PPE and excavation and drilling equipment, at levels that require radiological controls. Field contamination monitoring and provisions for personnel and equipment decontamination will be required to keep potential worker contamination as low as reasonably achievable and to confirm equipment meets radiological free-release limits.

The potential for exposure to other hazardous substance contamination is not likely to result in significant risk to team members. Any exposure will be of limited duration, and the radiological controls will mitigate the likelihood and extent of any contamination that could pose a significant risk to workers. Under CERCLA, the U.S. Environmental Protection Agency considers environmental concentrations corresponding to a 1×10^{-6} to 1×10^{-4} cancer risk range and a total noncancer hazard index less than or equal to 1 to be adequately protective of human health. Even without specific controls, the levels of contamination from the OLF characterization pose a human health risk below or at the lower end of the acceptable CERCLA risk range, based on the CRA. However, IH controls may be required to supplement the RWP controls to aid in keeping exposures to hazardous substances as low as practicable for this work.

The following approach will be used:

- In addition to the basic PPE indicated in the JSA, the Geoprobe operators and personnel needing close access to the Geoprobe sampling equipment and sample location will wear disposable shoe coverings and chemical-resistant (e.g., nitrile) gloves.
- The H&S Specialist/RCT will monitor the work area with appropriate field instruments to determine whether levels of contaminants exceed threshold for implementing a contamination exclusion zone and identifying additional PPE and/or monitoring.
- If threshold limits are exceeded, the H&S Specialist/RCT and IH will establish the appropriate controls in accordance with the JSA and, if above radiological thresholds, in accordance with the RWP.

9.3 Training

Training requirements will be graded according to whether the team member requires access to any contamination or exposure control area and also to the person's level of previous training and experience. The field team members must be current on H&S training required for their respective job classification.

Training includes a review of this SAP, the JSA, and emergency response planning for the RFS. Although the team members are not likely to be exposed to radiation or radioactive materials above administrative control limits, the Geoprobe operators have radiation worker training to help ensure radiation doses are as low as reasonably achievable.

If respiratory protection (respiratory protection means wearing full-face air-purifying respirator) is required due to actual or potential airborne contamination, work will be paused and evaluated by H&S, RCT, and CIH team members. Work will be evaluated to determine if engineering or other controls can reasonably be used to eliminate the hazard or if changes to the SAP may be required. The number of persons entering the airborne contamination area requiring respiratory protection will be minimized to the extent practicable.

Observers (such as managers and regulatory staff) are not part of the field work team but may be present in the immediate vicinity with the approval of the H&S Specialist/RCT and will follow the directions of the H&S Specialist/RCT.

A daily safety meeting and pre-job brief will be conducted prior to starting work for that day.

10.0 References

6 CCR 1007-3 Part 265, Subpart G, Colorado Code of Regulations

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